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N.A.A. BULLETIN

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April 1960

In Two Sections
Section 1

New Tools in Reporting

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Public Utilities — Three Cases

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Direct Costing and Pricing

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Problems in Working with E. D. P.

N.A.A. BULLETIN

Vol. XLI No. 8 APRIL 1960

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Advanced tools and techniques, such as electronic computers, integrated data-processing, operations research, etc., have tremendously increased capabilities in the area of reporting financial data to management. The author not only emphasizes their actual impact on accounting information and its presentation to management but also points out how the accounting profession can meet the challenge they represent and make full use of its new opportunities 59

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Slides projected on the screen, as described in this article, show the company's latest financial developments to an audience made up of its executives. A member of the controller's staff assists with explanations and answers to questions that arise. Not a substitute but a supplement to the financial statements in the conventional form, the method used is rather fully set forth and illustrated, including how to put the information on the slides, how to make good slides, what to cover and how to prepare oral comments 77

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The author of this article does not attempt to attribute to mathematics the role of a substitute for creative thinking; he simply illustrates how it can be turned into a helpful tool in approaching and solving some of the problems facing each accountant, and how accountants, sometimes helped by mathematicians, can, without use of too complicated formulas, avail themselves of this tool to accomplish a great deal more than at present 27

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by H. DONALD CUNNINGHAM

There are compelling reasons for extensive cost control in a public utility, even though the costs of its services are fully covered by the established rates, and, also, there are a number of actions which may be successfully undertaken, in correcting unfavorable conditions as well as in improving cost performance, within an over-all cost control program. Such a program is presented in this article 5

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by WILLIS R. COX AND JOHN S. ODOM

The long-range objective of the program presented is a "highly-mechanized and fully-integrated system of data processing for all types of materials" used by a company. Preliminary studies disclosed that deficiencies of the present system could be eliminated only by a general approach to the problem of excessive paperwork. The program was advanced gradually by working out problems of one section at a time. Its successive steps, phases and accomplishments are set forth in this article, as well as benefits which are expected to eventuate 37

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A Cost Control Program in a Public Utility

by H. DONALD CUNNINGHAM

THE QUESTION is often asked as to why a public utility should effect cost control programs. To the casual observer this is certainly a valid question. He believes that full operating costs are allowed in the establishment of rates, hence such costs are passed to the consumer, and that a utility has a veritable monopoly in the area that it serves. However, there are a number of reasons why an extensive effort should be made to control costs. Three of the more prevalent reasons are:

Public Relations. Inflation has caused utilities to make innumerable applications for rate increases and each increase causes unfavorable headlines promoting unhealthy public relations. Cost control programs cannot entirely reverse the effect of inflation but they do extend the time interval between rate applications.

Growth Factors. A rapid rate of growth creates new operating conditions which necessitate commensurate methods of control. Organizational requirements may get out of balance as people tend to justify what goes on and what it costs, unless facts are presented to jolt their complacency. Management must rely more and more on people down the line. Greater responsibilities must be delegated with increasing control effected by use of reports.

Competition. Lower rates make a product or service more competitive. The general public believes that since a utility has an area monopoly, it encounters no competition. This is far from being the fact. Utilities compete with each other for consumer usage. For instance, gas utilities have competition from electricity and fuel oil concerns.

Southern Counties Gas Company of California is a medium-sized gas utility, with 2,000 regular employees, which serves 700,000 customers in Southern California. Its eight distribution divisions and three transmission districts are spread over an area approximately 400 miles in length. The company has a strong decentralization policy. Division managers are responsible for getting out the day-to-day work, while the officers and general office department heads perform functional control through establishment of policy, procedures and objectives.

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The company is engaged in a continuous program of extending and enlarging its facilities to meet the increasing demands on its system. Since 1950 there has been a 95 percent increase in the number of customers served, requiring an annual outlay of approximately $20,000,000 for new pipelines, meters, regulators, buildings, etc. It was this rapid growth and its effects that, in 1955, prompted a review of our cost and organizational structure. It was readily ascertainable that better ways of controlling operating costs should be employed—cost responsibility at the lower levels of management was not clearly defined, cost reporting at these levels was negligible and costs were not being measured against targets or standards.

With these revelations in mind, a control program was outlined and the accounting department was charged with the responsibility of successful implementation. The procedures which we followed and which, we believe, are necessary for a sound control program are discussed here, in order that others may profit from our experience.

Three Aspects of a Cost Control Program

Three integral areas of control, each important in itself but dependent upon the others for successful performance, are cost responsibility, cost measurement and cost reporting.

The *cost responsibility* aspect of the program must be based upon certain basic principles. Sound organization is a prerequisite for good cost control. Responsibilities should be clearly defined and cost responsibility should parallel the functional responsibility established by the plan of organization. Reporting relationships and channels of communication should be simple and direct. Every dollar of cost should be assigned to a responsibility in order to provide comprehensive control; however, each supervisor having cost responsibility should be held accountable only for costs over which he has a reasonable amount of control.

Cost Measurement. Objective and "forward-looking" standards are the yardsticks that should be used to measure cost performance. Standards provide management and supervisors alike with a common basis for appraising operating costs and making fair performance comparisons. Standards of measurement for cost control can be developed in several patterns. They are, in effect, estimates of what can be accomplished with high-level performance. Regardless of how these estimates are derived, they should be equitable with each other; that is, 100 percent performance in a given element of work should represent the same level of achievement in all cases. It is most important that the standards be acceptable to the individual whose performance is to be measured.

Cost Reporting. The effectiveness of performance measurement is dependent to a large extent upon the accuracy and completeness of the actual cost and production data. A major objective of cost control should be to develop cost consciousness throughout the management team. Effective cost reporting is a key factor in achieving this objective. Actual costs and production data should be reported completely and accurately and the reports should be simple and prompt. Systems for collecting and reporting cost and production data should incorporate the following principles:

1. Actual costs should be collected in accordance with a two-dimensional pattern—by area of functional responsibility (cost center) and by element of cost.
2. Reports should be issued promptly at the close of the period to each supervisor having cost responsibility.
3. The cost element breakdown should provide supervisors and management with adequate and practical cost segregation for control purposes.
4. Reports should emphasize the extent of major deviations from standards and thus provide control by exception.
5. Charts and other graphical aids should be employed wherever possible, to visualize performance trends.

Laying the Groundwork

Four basic areas of endeavor inherent in successful implementation are: (1) developing cost centers, (2) training personnel in the development and use of standards, (3) developing and maintaining the cost reporting system and (4) advising management in the use of the program.

The first step to be taken should be to confer with all officers and department heads. It cannot be over-emphasized that the participation of the affected department heads in the planning stages of any system installation is a prerequisite of achievement. As a result of this initial meeting, the first department in which the program is to be initiated may be selected. We, naturally, chose for the test department one which appeared most receptive to the program (in our company it was the customers department, and its staff has since been our best salesman).

The next step is the determination of cost centers with the staff of the selected department. Certain ground rules may be established to be observed in implementing the program, such as:

1. Each cost center should represent the responsibility of a single person. However, a supervisor may have the responsibility for more than one cost center.
2. Each employee and each item of cost should be assigned to one, and only one, cost center.
3. Only the costs over which the supervisor has some degree of control should be assigned to his cost center.
4. Allocations and other charges unrelated to cost center responsibility should be avoided as much as possible.

After defining and outlining the program, a review of the job operations to be covered by the various cost centers is necessary. Existing lines and levels of supervisory responsibility in each of the company's operating divisions must be ascertained. It may soon become apparent that some existing assignments would have to be ignored if the principles of cost centers are to be followed. New assignments may have to be made in conformity with the program. After the review and realignment, if necessary, of job operations to be included in the cost centers, division management should be met with, the program explained, and the proposed cost centers discussed. Changes may result from these meetings until a final proposal is agreed upon. Considerable time may be spent in

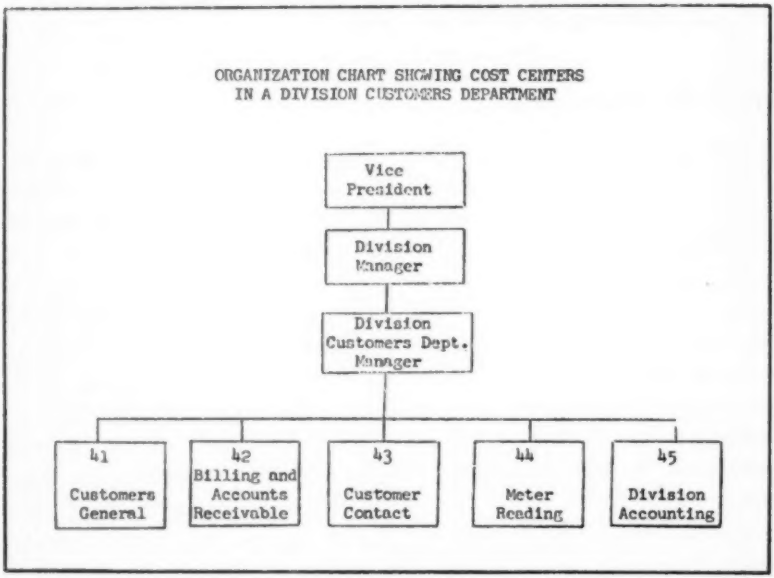

EXHIBIT 1

obtaining agreement and understanding with all the people who will have cost center responsibilities but the results will show that this time is well spent. As a result of these procedures, in our case, five cost centers in the customers department of each division were established. Exhibit 1 shows the organization of the customers department established to place cost control into operation.

Establishing Performance Measurement

Now that the cost centers have been established, the next step is to develop standards for the measurement of costs to be reported by the cost center. In many cases, it is unnecessary to utilize time study in the development of cost control standards and, in fact, it may be undesirable (we did not develop any time study standards to be used for cost control). Less well-engineered standards may be used in both clerical and field work where there is any amount of re-

COST CENTER 43 CUSTOMER CONTACT AND CASHIERING

Operation: Collection Notices (for Divisions with Tab Billing)

Clerical Steps	Standard Allowance
1. Stuff Reminder Notices and Post Card Bill into envelope for mailing	.010 min/connected meter
2. Review E-41.4 Notices, check for extensions and stuff into envelopes for mailing	.008 min/connected meter
3. Review E-41.6 Shut Off Notices, check extension file and route to field	.020 min/connected meter
4. Budget Allowance: (a) Maintain office-copy file (b) Prepare extensions and follow up (c) Check for payments (d) Send out follow-up orders (e) Follow-up work on closing statements, including mailing notices, preparing and mailing collection letters and collection agency work	.107 min/connected meter
Normal Time	.145 min/connected meter

Allowances: 6% Fatigue
5% Personal
2% Unavoidable Delay

Standard Time: (.145 x 1.06) 1.07 = (.165) min/connected meter

Figures are for illustration only.

EXHIBIT 2

petitive-type operations. These standards can be developed through discussion with supervisors who are familiar with the work, by inspection of records of past performance and by rating of the pace at which work is being done. (Exhibit 2 depicts the development of one of the standards in Cost Center 43). Each department should be responsible for developing and maintaining its own standards. The function of the controlling department (in our case, the accounting department) is training staffs of the various departments in the development and use of standards. It may be advisable to engage outside industrial engineering help for this training function.

After standards are developed, all allowances should be discussed with the cost center supervisors concerned to further increase their understanding of the program and ensure a feeling of participation. There is probably more apprehension on the subject of standards than on any other part of the program. Enlistment of participation by the supervisors in the standards development will allay this apprehension.

Standards are the best measure of whether costs are excessive or not, and in most areas of the divisions we have been able to employ them. However, in areas where there is no volume of repetitive-type operations, a budget may be used more favorably to measure costs, such as in certain parts of the general office. When a budget is used, the cost center supervisor should prepare it and secure the approval of his division manager or department head. It should then be sent to the accounting department to be used on the cost center reports in the measurement of actual costs.

Collection and Reporting of Costs

At the same time that the cost centers are being established, a review should be made of the elements of costs subject to the control of the cost center supervisors. This will result in a list of cost elements common to all cost centers, principally labor and related expenses. Other special cost elements may be established for each cost center to report costs peculiar and significant to the cost center. For accounting purposes, each cost element is numbered.

To accumulate costs by cost center, the cost center and cost element numbers must be placed on all source documents, such as time reports, invoices, etc. In order to apply the standards, each division provides production counts for the month for each operation on which there is a standard. For instance, there is a standard for the clerical work in sending out collection notices. Since the standard is per connected meter, the production count is the number of connected meters in the division for the month. Exhibit 3 lists, for each operation

STANDARDS CALCULATION SHEET

COST CENTER 43 - CUSTOMER CONTACT AND CASHIERING

Division: ORANGE COUNTY
Month of: OCTOBER, 1959

Operation		1. Determinant	2. Production X	3. Standard Rate/Minute	4. Total Standard = Minutes	P.U.C. Distribution $	P.U.C. Distribution Account No.
Clerical Labor							
1. Cashiering							
a. Counter Payments	(11)	Counter & Door Box	42,299	1.117	47,248.0		
b. Mail Payments	(11)	Mail Payment	117,650	.703	82,708.0		
c. Payment Offices	(11)	Payment Office Pmts.	21,797	.23	5,013.3		
d. (IDT's and ICT's)	(11)	Total Transfers	217	1.0	217.0		
2. Bank and Cash Reports		Work Days/Month	22	945.0	20,790.0		
a. Budget Allowance	(7)	Connected Meters	188,678	.105	19,811.2		
3. Meter Book Maintenance							
a. Turn On	(3)	On Orders	5,332	3.21	17,115.7		
5. Collections (Cler.)	(7)	Connected Meter	188,678	.165	31,131.9		
6. Misc. Budget Allowance	(7)	Connected Meter	188,678	.05	9,433.9		
Sub-Total					461,817.7	95.9%	780.1
7. Billing Record Maintenance							
a. Rewrite Meter Books	(7)	Connected Meter	188,678	.047	8,867.9		
b. Budget Allowance	(7)	Connected Meter	188,678	.029	5,471.7		
c. Fast Meter Calc.	(4)	PMC-RMC's	383	.90	344.7		
d. Guaranty Deposit	(7)	Connected Meter	188,678	.026	4,905.6		
Sub-Total					19,589.9	4.1%	781.1
					481,407.6	100.0%	

Standard Hours (Total Col. 4 ÷ 60) 8,023.5
X Standard Rate per Hour $ 2.40
= Standard Costs $19,256.40

Figures are for illustration only.

EXHIBIT 3

COST CENTER REPORT

COST CENTER 43 CUSTOMER CONTACT OCTOBER 1959 Division: ORANGE COUNTY

Current Month				Cost Element	Year to Date			
Actual Cost	Standard Cost	Under/Over(-) Standard	%	Description	Actual Cost	Standard Cost	Under/Over(-) Standard	%
				Base Labor				
22,902	19,256	3,646-	84	ADMIN & CLERICAL	206,530	179,202	27,328-	87
614		614-		OVERTIME PREMIUM	1,715		1,715-	
495	578	83	117	SICK-PERS-EMERG-JURY	5,447	5,377	70-	99
578-		578		PROD LABOR TRANSFERS	4,599-		4,599	
23,433	19,834	3,599-	85	TOTAL BASE LABOR	209,093	184,579	24,514-	88
				Other Labor				
1,468	1,468			SUPERVISION	11,822	11,822		
1,024	1,024			VAC-HOL-MILIT LEAVE	12,154	12,154		
1,012	1,012			TRAINING	3,626	3,626		
				EMPLOYEE ACTIVITIES	290	290		
3,504	3,504		100	TOTAL OTHER LABOR	27,892	27,892		100
26,937	23,338	3,599-	87	TOTAL ALL LABOR	236,985	212,471	24,514-	90
				Other Costs				
121	121			MISC OFF/FIELD SUPP	1,270	1,270		
61	61			PERSONAL EXPENSE	439	439		
41	41			AUTO MILEAGE	92	92		
1,432	1,432			PAYMENT OFFICE FEES FORMS	12,623	12,623		
1,655	1,655		100	TOTAL OTHER COSTS	14,424	14,424		100
28,592	24,993	3,599-	87	TOTAL COST CENTER	251,409	226,895	24,514-	90

Figures are for illustration only.

EXHIBIT 4

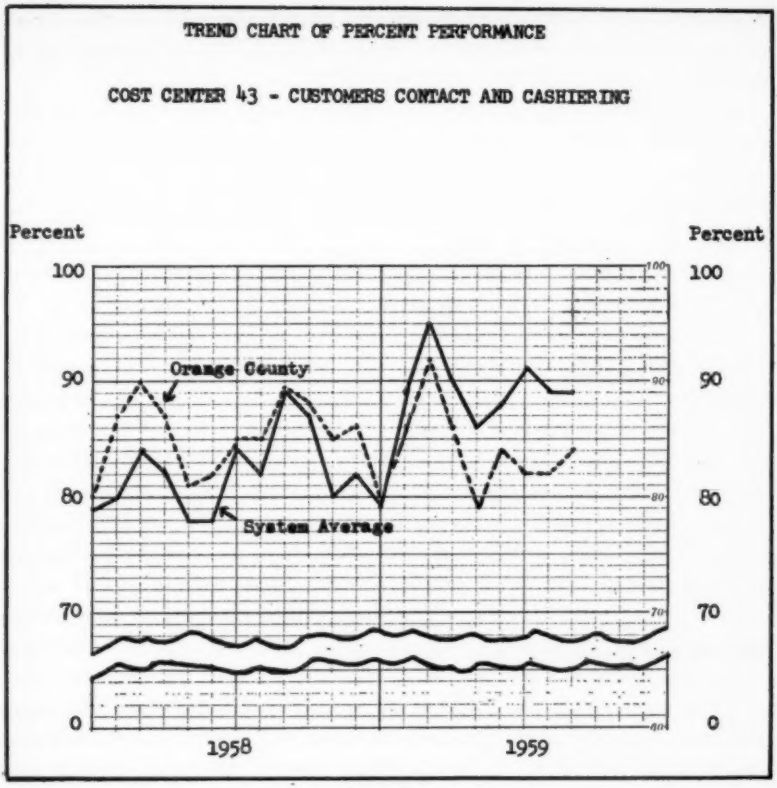

EXHIBIT 5

performed in the center, the production count, standard and standard labor cost for the month. Note that the standard for collection notices (.165) on Exhibit 2 also appears on Exhibit 3 as Item 5.

In order to maintain a control on the reporting of production and costs, the internal audit staff should perform periodic audits of both source documents and production counts.

An extensive effort should be made to charge a cost center supervisor with all the costs over which he has any control and, also, to see that he is not charged with any costs over which he has no control. He should not be burdened with any allocations. Labor, which is the principal cost in most cost centers, must be tightly controlled. An employee assigned to one cost center may not charge another center; the only way a supervisor may transfer the labor cost of an assigned employee is by agreement with another supervisor. These labor transfers are con-

trolled by a labor transfer sheet showing the name of the employee, the number of hours to be transferred and the initials of the cost center supervisor to be charged.

The accounting department's function in the program, other than control, is to collect actual costs, labor transfer information and standard (or budget) costs, and prepare Cost Center Report (Exhibit 4) in which actual costs are compared with standards or budget for both the current month and year to date. The standard labor cost for all operations for the month ($19,256.40), computed on Exhibit 3, appears on Exhibit 4 opposite the actual labor cost. Each cost center supervisor receives a copy of the report.

Because of the various departments involved in the standards aspect of the program, the percent performance in one cost center may not necessarily be comparable with that in another center within the same division. An 85 percent performance in one center may be equal to 80 percent in another. However, an excellent comparison can be made among the same cost centers of all divisions. A typical trend chart which compares a cost center with the same centers in other divisions is depicted in Exhibit 5. (Note the typical upward trend of the average). This chart permits a division manager to see how the performance of his cost centers compare with similar centers in other divisions.

Relation of Costs to P. U. C. Accounting

Those not familiar with public utility accounting may not know that public utilities must report all revenue, expenses, plant expenditures, etc., to their state public utility commission or to the Federal Power Commission, using a chart of accounts required by the commissions. Most utilities have taken the easy way out and have used the commission's accounts, subdividing them for internal management use. The step taken by our company in substituting a cost center for several subdivided commission's accounts was quite a departure from the normal utility practice.

During the development of each cost center the emphasis was placed on developing the cost elements needed by the cost center supervisor rather than the commission's accounts to which costs ultimately will be assigned. However, after the cost center was developed and cost elements selected, then the method for transferring costs to the commission's accounts was worked out. Here are four ways in which it may be done:

1. The total costs for the cost center may be transferred on the basis of the work performed, as indicated in Exhibit 3. Note that the operations are listed by account and that, beside each account

number (on the right side of the exhibit), is the percentage of the total costs to be charged to it. We believe that this is a better basis than asking each employee to indicate on his time report each day the amount of time to be charged to each account.

2. In many cases, the cost element itself indicates the commission's account to be charged.
3. Where work orders for plant expenditures, etc., are involved, the work order number is shown on source documents in addition to the cost center and cost element numbers. This permits the accumulation of costs not only by cost center but also by work order.
4. Where none of the above methods is available, predetermined percentages are used.

Cost Control Pays Off

The objective of the entire program is to generate prompt and effective action in correcting unfavorable conditions and in improving cost performance generally, throughout the company. All the work in developing standards and in reporting performance is to no avail if the operating organization does not utilize this cost control information actively in achieving the company's cost objectives. Our program has been accepted enthusiastically by line supervisors and daily we see evidence of the use of standards and cost information in controlling costs. Improvements have been brought about, primarily, by simply giving the supervisors performance information to work with. Of course, there was also good management interest and follow up of results, which served to encourage corrective actions.

The cost control program is reducing costs in areas that are "fat"; for example, some cost centers have achieved personnel reductions of 40 percent. In other areas, the program provides a control to see that costs do not get out of line. In addition to controlling and reducing costs, the program provides standards which may be used in planning and scheduling work.

As one of our top executives put it, "Any person who is a representative of management should want to do his best in controlling costs." We certainly feel that a sound cost control program is a tool that any representative of management must have to perform properly in his job.

Human Relations and the Work of the Accountant

by PALMER L. QUARTERMAN*

MOSTLY, the *Bulletin* and other N.A.A. activities concern "accounting" and "accounting related" topics. This is understandable since the Association is an accounting organization. However, I feel that many of the problems which those of us in accounting jobs encounter originate from sources other than the technical aspects of accounting. In fact, I might say, the majority of the practicing accountant's problems are in the field of personnel or human relations. They have an extremely wide range, from the seemingly trivial to the obviously important. Some of the situations which have come to my attention over the years in both private and public accounting and which tended to create problems are as follows:

—a new accounting system is installed. Old employees find it difficult to learn the procedures and to adapt themselves to the system. Other capable employees are hostile to the change.

—due to a change in accounting procedure, the job performed by a long-time employee is eliminated. Because of length of service and past loyalty, the company does not desire to let this person go. Another job is open, but this individual is not fully qualified to handle it.

—petty jealousies arise because of assignment of more modern equipment and more pleasing duties to others in the department.

—employees whose jobs require close cooperation have personality traits which are not compatible.

—effective employees develop physical handicaps which prevent them from working long hours or under pressure.

—personal problems of employees cause them to be less efficient in performing their duties.

—fellow department heads do not follow established accounting procedures in processing necessary paperwork.

—the management hires employees to fill vacancies in the accounting department without consulting the department head or considering the qualifications required.

—the management instructs the accountant how to record certain transactions, without regard to good accounting principles.

The above are but a few of the personnel matters with which the accountant is confronted. The examples cited have no easy solution, perhaps no final solution at all. However, it is felt that increased discussion among accountants of these and other problems of personnel management would do much to provide a practical help in coping with them.

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* Assistant Controller, Knox Glass, Inc., Jackson, Mississippi.

Direct Costs Are Better for Pricing

by WILMER WRIGHT

IN APRIL 1953 N.A.(C.)A. Research Series No. 23 on direct costing, referred to failure to provide a total cost for pricing as one of the disadvantages of direct costing:

> "Complete manufacturing cost is not determined in the process of costing production and supplementary allocation of fixed overhead on normal or some other volume base must be made to provide product costs for long-range pricing and other long-range policy decisions."

Since that time, practical techniques for pricing with direct costs have not only eliminated this as a disadvantage but have also converted it into one of the greatest benefits of direct costing. In order to understand these new techniques, it is important to review the role that costs play in competitive pricing decisions. Shown below are the four basic situations in which pricing decisions are made and cost has a different role in each:

1. *Products made to order.* Costs have a very direct bearing on prices. The bid price is determined by adding certain mark-ups to cost estimates. These mark-up factors are reduced when too many bids are lost. They are increased whenever it is felt that an adequate share of the market can be secured with the higher prices. Pricing in the printing industry is a good example of this method.
2. *General competitive products.* Prices are based on a mark-up on costs. They are usually set by a leading company; the rest of the industry follows and its costs are used for selective selling. This has been called administered prices.
3. *Products with a price set by custom.* Costs determine the weight or quality of product that can be offered. The usual practice is to work backwards from the retail price to determine the kind of product that can be offered. This may mean developing better methods or substitute materials. The five cent candy bar is a typical example.
4. *Products of standard quality and form.* Costs simply tell management whether to produce or not to produce. Thus, the marginal

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WILMER WRIGHT, New York Chapter, 1946, is President of Wright Associates, Inc., New York, N. Y. After three years with Western Electric Company and a year as independent consultant in Baltimore, Maryland, Mr. Wright joined the staff of Stevenson, Jordan & Harrison in 1933. In 1958 he resigned, as a Senior Partner, to form Wright Associates. He is a graduate of the University of Michigan, which, in 1953, awarded him a citation in recognition of his contribution to advanced concepts of profit planning and control. Mr. Wright is frequently called upon for technical speeches and is the author of many articles. He is a previous contributor to the *Bulletin*.

producer's costs at a given level of demand determine the market price. This method is applied to the setting of prices in the commodity markets.

In all these situations, direct costing techniques provide better data for pricing decisions, to achieve capacity levels and to maximize profit by selective selling after capacity is reached. However, it is important to keep in mind that estimated costs, whether total or direct, are used only as a starting point in determining selling prices.

Direct Costing Simplifies Pricing Decisions

In companies in which direct cost data are not available, the most prevalent method of determining costs for pricing products is as follows:

1. Production cost centers are established by machine or process.
2. All departmental labor and expense, service department expense and fixed (or period) manufacturing expenses are distributed to the cost centers.
3. Costing rates per unit (usually man-hour or machine-hour) are set for each cost center based on either the normal level of activity or the forecast.
4. The cost estimate for a given product shows the man or machine-hours for each cost center and the quantities of material required per unit.
5. The man or machine-hours, extended by the costing rates, and the quantities of material extended by the estimated prices, are totaled to get aggregate manufacturing cost.
6. To that total, a percentage is added to cover selling and administrative expenses and, also, another one, to provide for a profit.

In most cases, using absorption costing, the accounting department watches the overhead rates. Whenever volume of production fails to absorb the total cost of a given cost center, the rates are increased; when the volume over-absorbs the burden, the rates are reduced. Carrying the logic of this method of competitive pricing to an extreme, one of two situations must result:

Case 1: The product is priced below the competitive level and volume is increasing. Burden rates are reduced because the factory burden is being over-absorbed. This results in lower prices which cause volume to increase faster until the point is reached at which orders exceed capacity.

Case 2: The product is priced above the competitive level and volume is dropping. The costing rates are increased, to absorb the burden on the lower volume. This results in higher prices; the product becomes even less competi-

tive and volume drops faster. Costing rates are to be increased again, and so on, until volume is zero and the costing rate is infinite.

In the first case, the company fails to maximize profits within the plant capacity; in the second, the company goes out of business. In the light of these results, it seems absurd to imply that any accountant would tell management to increase prices when the company is losing business to competitors and to reduce prices while taking business away from competitors. It is absurd when carried to extremes in a simple situation, but it is happening, to a limited degree, every day in thousands of complex businesses which use the absorption or whole-cost basis for the pricing of products.

Many companies solve this problem by using a long-range volume or capacity basis for setting burden rates. It has been stated in one of the Association's research reports:

> "Over the long run, management's pricing objective is to obtain prices for the company's products which will return all costs and provide an adequate return on capital invested. For such a purpose, long-run normal or average cost of the product constitutes a better guide than does the cost which prevails in any given short period. One reason for this is that unit costs based upon short-period volume rise as volume declines and fall when volume rises. If management should follow short-period average costs in pricing, it might expect serious reduction in its share of the market potential if it increased selling prices in a time when activity in the industry was falling. On the other hand, to lower prices when a temporary rise in volume occurs destroys the opportunity to recover losses suffered in periods of low volume. These disadvantages can be minimized by developing product costs in which the fixed costs are spread evenly over the number of units produced during a period long enough to average out short-period volume fluctuations." (*N.A.[C.]A. Bulletin,* Section 2, August 1953, Research Series No. 24, p. 1709).

For example, General Motors uses a level of activity based on a fixed percent of capacity in unitizing its period costs. Unit costs fluctuations from year to year therefore reflect changes in material costs, wage rates and operating efficiency only. Accountants who use this long-range volume method of allocating fixed (or period) costs avoid the absurdity of telling management to raise prices when the volume of sales is shrinking. However, they still fail to give management cost data of most assistance in selecting the best price to meet a given competitive situation. Many go through extensive computations of comparative over-all costs and profits with a given order at various selling prices. This is time-consuming and costly. Obviously, it can be justified only with large orders.

By using direct costing techniques for pricing products, all this confusion and complexity can be avoided. With direct costs data, most pricing decisions can be made by non-accounting executives, using simple arithmetic.

Direct Costing and Long-Range Policy Decisions

The advocates of absorption costing suggest that direct costs serve for a simple one-product business, but do not cost individual products fairly. They point out that, in actual practice, you usually have many products that use different proportions of the time of costly facilities. They say, "How do you know that each product is carrying its fair share of burden if you do not allocate fixed manufacturing costs to products?" Here is one of the most widely held misconceptions about direct costing!

XYZ COMPANY
PROFIT PLAN (000 Omitted)

DESCRIPTION	TOTAL	LINE X	LINE Y	LINE Z	IDLE PLANT
Sales Forecast	$70,000	$10,000	$20,000	$40,000	0
Direct Cost					
Material	$30,000	$ 2,000	$ 8,000	$20,000	0
Direct Labor & Exp.	23,000	3,000	6,000	14,000	0
Total	$53,000	$ 5,000	$14,000	$34,000	0
Margin	$17,000	$ 5,000	$ 6,000	$ 6,000	0
% of Sales ("P/V")	24%	50%	30%	15%	
Planned Period	12,100	2,500	4,000	5,500	100
Net Operating Profit	4,900	2,500	2,000	500	(100)
% of Sales	7%	25%	10%	1.3%	0
Capital Employed	33,000	10,000	12,000	10,000	1,000
% Return	15%	25%	16.7%	5.0%	(10%)

EXHIBIT 1

With a standard direct cost system, period costs are allocated to products or product groups as part of the profit planning operation at least once a year. However, they are allocated in total for the planned volume and sales mix. They are never unitized. It is the unitizing of period costs that makes absorption costs confusing to operating managers because these unit costs are valid only with the assumed volume and mix. By showing the allocation in total, along with the forecasted volume and mix, this confusion is avoided. Operating management can see clearly the true inter-relation of prices, costs and volume.

The profit plan for the XYZ Company (Exhibit 1) demonstrates how this works. Not only are period charges allocated to product groups but capital employed is also allocated. This method permits a realistic appraisal of both short-term pricing and long-range planning. By carefully selecting the product groups, the profit plan will show not only whether each product is carrying its fair share of burden but also whether or not it is providing a proper return on capital employed. This is the true measure of profitability, according to most authorities. It should be noted that the profit plan has a column for idle plant which permits the use of a long-range volume basis for product pricing while, at the same time, providing realistic profit plans for the coming year. This column shows a profit in any year in which the planned volume is above the selected normal percent of capacity and a loss when it is below normal. A study of Product Line Z shows that it helps the short-term picture because of the six million dollar margin. However, the return on capital employed is so low that long-range plans must be made to improve the percent margin or replace the line because at no projected volume, with the present profit/volume ratio, would there be an adequate return on capital employed.

Direct Costing and Day-to-Day Pricing Decisions

How does one arrive at a target selling price with direct costing data? One method is to divide the estimated direct cost of the item to be priced by the complement of the profit/volume ratio for that product line. Thus, the "right" price for a new product which is to become a part of Product Line Y and the direct cost of which is estimated to be seven dollars per unit would be as follows:

$$\text{Suggested price} = \$7.00/(1.00 - 0.30) = \$10.00$$

In actual practice, mark-up factors which also take into account the discount structure are usually computed in advance so that the suggested selling price is determined by multiplying the direct cost by the proper mark-up factor. For example, in a handmade-glassware company which used direct costs for pricing, the mark-up factor includes the dealer's mark-up so that when the

direct cost is multiplied by the mark-up factor the "target" retail price is determined. The merchandising and pricing executives then compare the new item with other items in the line and select a price that will look appropriate to the retail customer. If this price fails to provide an adequate ratio, consideration is given to either redesigning the piece or not adding it to the line.

This method works well if the material content is small or the proportion is relatively constant within a product division. However, in product divisions in which the relative material content varies widely, it is necessary to use a different mark-up on material from that used on direct conversion cost. For example, assume that two new products have been designed for Line Y. Product A requires extensive machining processes using costly facilities. Product B is an assembly of expensive purchased parts. Use of the same mark-up on material and conversion cost for these two products would result in a suggested price too low for the fabricated product and one that is too high for the assembly.

Companies using direct costs for pricing have various methods of solving this problem. For example, a well known rubber company applies the mark-up to the direct conversion cost and then adds the material cost without mark-up. A manufacturer of upholstered chairs adds a mark-up to the material content based on the turnover rate and another mark-up to the direct conversion cost to provide a target return on capital employed. With this as a guide, the price is selected by comparing it with those of other chairs in the line. Then the conversion mark-up for the selected price is computed. If this mark-up is below a certain minimum, the chair is redesigned or dropped. This method is believed to be the most effective, and direct costing provides a simple procedure for selecting mark-up percentages that will provide a target return on capital employed for any relative ratio of conversion cost to material cost. The procedure can be used by any company that has direct product costs.

Developing the Pricing Formulas

Take, for example, the XYZ Company. As stated above, Product Line Y has a number of individual products which show a wide range of relative material content. Therefore, instead of dividing the direct cost of a product by the complement of the profit/volume ratio, the proper mark-up for material, as distinct from conversion cost, must be determined so as to give the same return regardless of relative material content.

Exhibit 2 is illustrative. The present average return for Line Y is 16.7 percent on capital employed. Assume that the pricing committee selects a 20 percent objective. By working back from the capital employed, it is easy to

DATA FOR PRICING FORMULAS

PRODUCT LINE Y
(000 Omitted)

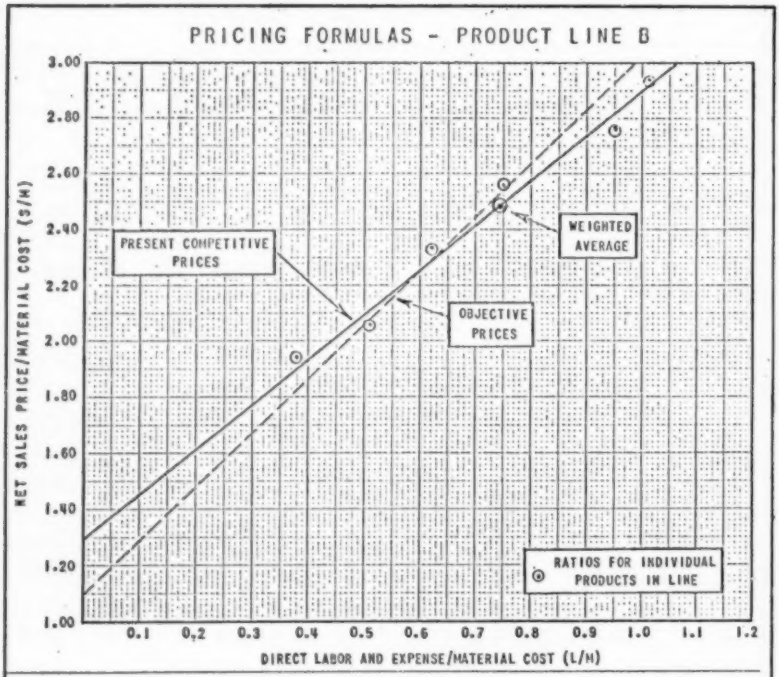
	PROFIT PLAN	OBJECTIVE
Net Sales (S)	$20,000	$20,400
Direct Cost		
Material (M)	8,000	8,000
Labor & Expense (L)	6,000	6,000
Total Direct Cost	14,000	14,000
Margin	6,000	6,400
P/V	30%	32.3%
Period Expense	4,000	4,000
Net Operating Profit	2,000	2,400
% of (S)	10%	11.8%
Gross Assets Employed	12,000	12,000
% Return	16.7%	20%
S/M	2.50	2.55
L/M	.75	.75

EXHIBIT 2

determine the objective margin ($6,400,000) and the objective sales income ($20,400,000).

The mark-up on the material content is determined by the objective return and the turnover rate. In the case of Product Line Y, the turnover was found to be twice a year, so that a mark-up factor of 1.1 on the material content

should produce a 20 percent return on capital employed. Thus the sales income that would be required to provide a 20 percent return on the capital employed in material ($8,000,000 multiplied by 1.10) is $8,800,000. The sales income required to provide a 20 percent return on capital employed in conversion is therefore ($20,400,000 less $8,800,000) $11,600,000. This, divided by the direct conversion cost gives the conversion mark-up factor ($11,600,000 ÷ $6,000,000 = 1.93).



PRODUCT	SALES PRICE	DIRECT COST MATERIAL	DIRECT COST CONVERSION	S/M	L/M
A	1.93	1.00	.380	1.93	.38
B	1.03	.50	.255	2.06	.51
C	4.66	2.00	1.240	2.33	.62
D	.64	.25	.187	2.56	.75
E	2.08	.75	.713	2.77	.95
F	.32	.11	.111	2.91	1.01

PRESENT COMPETITIVE PRICES:

MARK UP ON MATERIAL = 1.30
MARK UP ON LABOR AND EXPENSE =

$$\frac{2.50 - 1.30}{.75} = 1.60$$

OBJECTIVE PRICING FORMULA:

(20% RETURN ON TOTAL ASSETS)
S/M = 1.1 (TURNOVER = TWICE/YEAR)

$$S/L = \frac{2.55 - 1.10}{.75} = 1.93$$

EXHIBIT 3

The formula for competitive prices is determined as follows: A group of products that are believed to be competitively priced are selected. A list is made showing for each product the sales price (S), the direct material cost (M), and the direct conversion cost (L). The ratios S/M and L/M are computed and a graph using S/M as the ordinate and L/M as the abscissa is drawn. The line of best fit is selected by visual inspection or the method of least squares. This line represents the competitive pricing formula, and the objective pricing formula is then drawn. Such a comparison of competitive practices with objective return on capital employed provides a clear understanding of areas in which improvements can be made within the competitive structure. Exhibit 3 shows this development for the XYZ Company.

Pricing Inter-Divisional Transfers

In addition, is should be noted that the formulas for computing the mark-up factors for material and direct conversion cost that provide a selected return on capital employed also are most effective for inter-divisional price determination.

With the growth of decentralized operations and profit center control systems, the need for a more scientific method of establishing inter-divisional prices has become a major problem. A principal source of trouble is the accumulation of overhead in inventory. When a product is transferred from one division to another, the acquiring division usually carries its inventory at the transfer price. From then on, the acquisition cost is treated as a direct cost even though the transferring division has been credited with an amount that covers some period costs and profit. As a result, the true margin of a given end-product to the company as a whole is obscured. Top management cannot evaluate accurately which products to push through more advertising and promotion or for which to provide more funds for growth.

With the use of these direct cost formulas, such problems are eliminated. Inter-plant transfers are handled at direct cost, with material content kept separate from direct conversion cost by selected product groups. The mark-up on material and the mark-up on direct conversion are determined for each group to provide an objective return on capital employed. These mark-ups are applied to the totals transferred during an accounting period; the total margin above direct cost is credited to period costs of the transferring division and debited to the period costs of the receiving division. This may be done monthly or on a moving twelve-month average.

With this method, the end-product always shows a true over-all margin, there are no inter-divisional profits to be eliminated, and detailed clerical work is kept to a minimum. But, most important of all, inter-divisional "squabbles"

are avoided, because the prices are based on a mathematical computation that is clearly fair to both.

Opportunity for Accountants

Since these are such simple procedures, why does the most difficult problem seem to be to educate people in the use of direct costs for pricing? By and large, this is because financial and operating executives have felt that direct cost data would be misused by sales executives and that prices would be quoted lower than with total cost data. Actually, a broad survey of companies which have converted to direct costs has shown that sales executives generally have held the line better with direct costs than they did before conversion.

There are two reasons for this. First, there is a general misconception of the behavior of burden rates in absorption costs. The average sales or operating executive considers that any price that absorbs some manufacturing overhead will help the profit picture. A survey of companies using direct costing showed an average of almost half of the manufacturing overhead to be direct or variable. When a sales executive is told that, if his price is less than the direct cost, he will lose money out-of-pocket, he understands it and will act accordingly. With absorption costing, that point is not known. The sales executive thinks of all overhead as fixed; therefore, he uses wishful thinking to rationalize a price so low that it sometimes is below the out-of-pocket cost.

Second, with absorption costing, there is a confused responsibility picture in the profit and loss statement. This confusion is due to volume variances. With absorption costs, the true price-volume results of policies and practices of the sales and merchandising people are mixed up with the manufacturing volume variance. For the short term, production volume is controlled by the manufacturing people. Thus, the profit and loss statement fails to show whether pricing policies are paying off as planned. With direct costing, the volume variances are eliminated so that the over-all profit contribution achieved provides a clear measure of the effectiveness of pricing policies. The result: more mature and responsible pricing decisions.

In any pricing situation, it is the proper function of the accountant to present to operating management the profit results of various alternatives. No matter whether the problem is simple or complex, direct costing provides the best basis for both short and long-range decision-making. Eliminating volume variances achieves a clearcut separation of sales and manufacturing responsibilities and provides objective measurement of the quality of pricing decisions.

Mathematics Confronts the Accountant with Opportunity

by RICHARD L. YOUNG

SEEMINGLY, the accountant is dead as a dodo, with part of his job lost to transistors and all the rest going to decision equations. Actually, this should never happen, any more than it happened with the introduction of machine accounting systems many years ago. The accountant is a flexible kind of fellow —he learns fast. As soon as he learns how to use the newest development in data processing, he becomes even more valuable than before, as happened with, let us say, the desk calculator.

It is said that accounting work may be divided into two parts. One part is the accumulation, recording, and reporting of information. This, we are told, the electronic data processing systems are going to take over. The second part involves forecasting, controlling, analyzing and similar judgment and decision-making processes. These are all areas for the mathematician, armed with his correlation coefficients and a table of random numbers. But, just as mathematical developments have helped the engineer to do his job better, so will they be of help to us, as accountants, provided that we learn how to use them.

Keep Abreast of the Times — Mathematics May Help

In most cases, the accountant is better qualified than any other member of the management team to use mathematical analyses of operations. As a matter of fact, accountants have been doing operations research to a greater extent than any other function for years, both consciously and intuitively. In dealing with mathematics, the accountant might formulate five rules for himself:

1. Keep abreast of the mathematical tools available. This can generally be done fairly well by a review of accounting and management literature, and attendance at educational meetings. It also helps to have an occasional discussion with a true expert in this field.
2. Know when to ask for help. All of us have our limitations—and pride in ourselves often keeps us from asking for help when we

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should. On the other hand, accountants should be able to recognize problems which are amenable to mathematical treatment.

3. Make sure the mathematician understands the situation. The accountant can probably be of greater help to him in identifying the significant variables and the major relationships than any other single person.
4. Get into the mathematician's assumptions and results thoroughly. Make sure that his assumptions make sense, that his development is logical and follows through to his conclusions. Remember that, if he cannot explain the problem to the accountant satisfactorily, there are few, if any, others in the organization who have a chance of understanding him.
5. Work with the mathematician on presentation until you have something that anybody can understand. Perhaps this is an overstatement, but it is a truism that the easier an idea is to understand, the easier it is to sell it and, of course, the more probable it is that the idea will accomplish a useful purpose. This does not mean that you should simplify only the conclusions which you have reached. Present the idea *and* the steps leading up to it in understandable form.

To illustrate the third point above, here is one example of results which occur when the accountant does not work with a mathematician. Some years ago, one of our mathematically inclined associates decided to undertake an analysis of a particular kind of cost. Without the knowledge of the financial function, he made a mathematical analysis of monthly costs for a five-year period for several departments. After about six months of work, he presented his final report, completed with charts and graphs. His figures seemed clearly to demonstrate a lack of accounting control. After about four minutes of presentation, he was asked if his data were adjusted for his company's use of two four-week months followed by a five-week month in each quarter. Unfortunately, this had not even occurred to him, nor had it occurred to his colleagues. By assuming that data were on a calendar month basis, he had reached the erroneous conclusion that his company's accounting procedures for these kinds of costs were completely inadequate for control purposes. This is, of course, an extreme example; nevertheless, when physical scientists work in a vacuum, their assumptions on financial matters must be scrutinized carefully. (The reverse also holds true—when accountants work in the fields of mathematics, their mathematics should be scrutinized carefully.)

Some Approaches to Typical Problems

To illustrate some of the preceding points, it may be helpful to present sev-

eral examples of mathematical work as it is presently being performed in typical accounting functions. In the area of employee benefits accounting, for instance, consider a trusteed pension plan with more than 200,000 active participants, whose contributions and company contributions are held by a pension trust. In addition, more than 20,000 former employees are currently receiving pensions from the pension trust.

One of the jobs of the accounting function is to maintain records for this trust and to compute the liability accruing each year on account of employee earnings, the trust's experience, etc. Recently, the computations of liabilities were transferred over to a computer center. To illustrate the kind of mathematics which accounting people are performing there, Exhibit 1 (upper part) shows a typical valuation factor for pension liabilities. Incidentally, there are thousands of such factors. For ease in programming the computer to calculate a value for each of the factors, the valuation factor must be broken down into its component parts, as shown in the lower part of Exhibit 1. The different elements then may be held in the computer's memory storage and called out as required for each particular factor; this cut down considerably the number of characters which had to be carried in the computer memory.

PENSIONER LIABILITY VALUATION FACTOR

$$12\, a^{(12)}_{\overline{x:5-(n-t)|}}$$

CALCULATING FACTOR

$$\frac{N_x^{(12)} - \frac{1}{2}(N_{64}^{(12)} + N_{65}^{(12)}) - \frac{1}{24}(D_{64} + D_{65})}{D_x}$$

EXHIBIT 1

Another problem which faced the accounting people was the verification of the pension liability computation, which is made at the end of each year. There are basically three ways to do this: (1) to bring forward gains or losses and compare with a computer recomputation, (2) to build internal check into the computer program and (3) to tabulate the computer results and test-check.

The first procedure is to bring forward the former liability, adjusting for the

gain or loss on mortality, interest, etc., based upon all changes which have occurred during the year. This should be the same as the recomputed liability of the trust at the end of the year. This approach was found to be the best. A second alternative was to build an internal check on the computations into the computer. As a matter of interest, Exhibit 2 shows a page out of the middle of the notebook of one of the individuals who worked on this particular problem. The purpose in showing these notes is not to bedazzle the reader with complicated formulas; actually, the mathematics involved is not difficult. The point is that these kinds of calculations and this kind of work are presently being done by individuals who are accountants, not mathematicians. In general, the results from allowing people with financial backgrounds to get into this kind of work have been most satisfactory. Actually, to return to the computer programming problem, the second approach was found to be not feasible, since it would have taken considerably more computer time than the first method. The third method was rejected because it did not provide a complete check of the calculations.

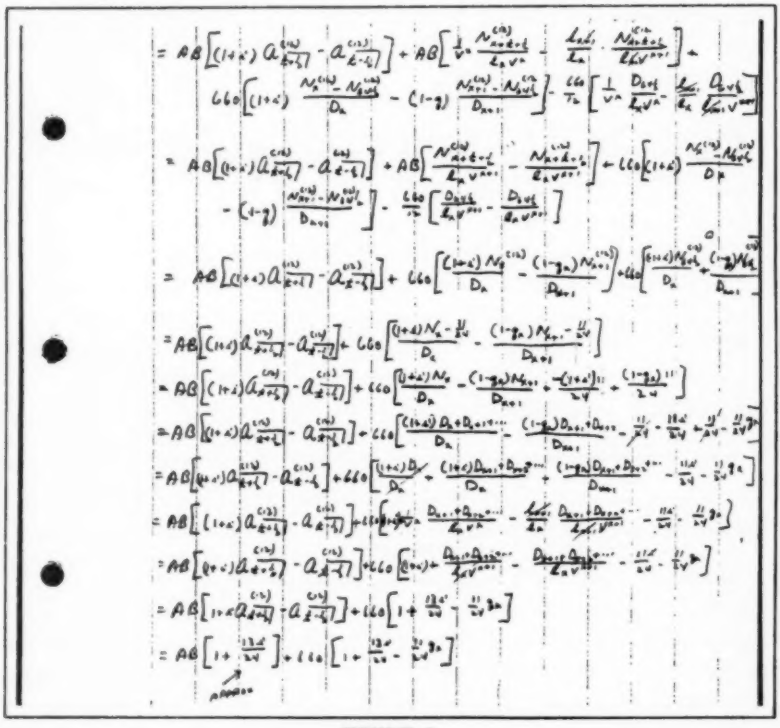

EXHIBIT 2

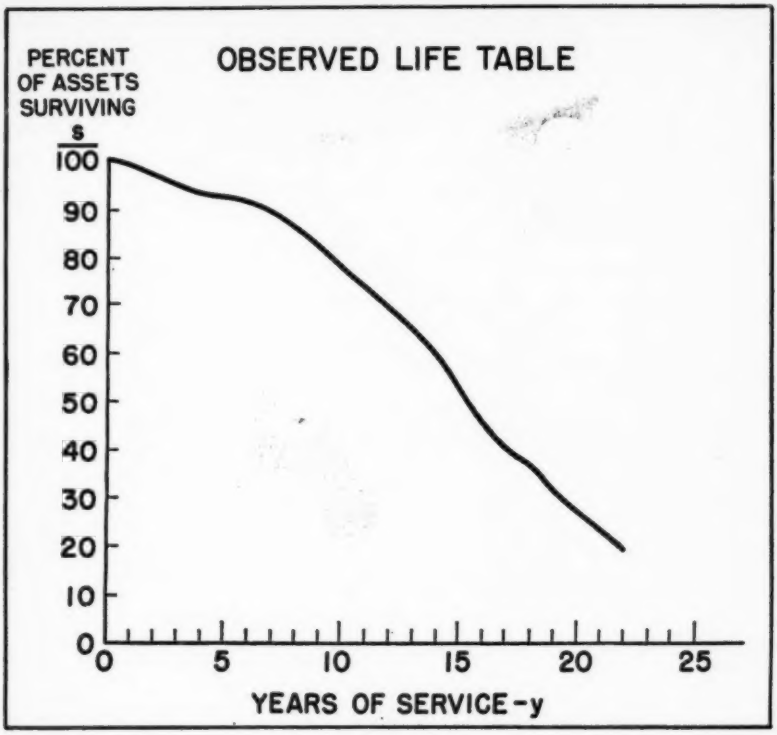

EXHIBIT 3

A somewhat similar problem is the construction of survivorship curves for fixed assets. This may be done periodically to check on the reasonableness of depreciation assumptions, determine those areas where there may be classification problems, and the like. Basically, a table of this type is determined by adding together like ages of equipment for a period of several years and determining the percentage of assets retired at each age. We then multiply the percentage of assets surviving after age one by the percentage surviving after age two, multiply the result by the percentage surviving at age three, and so forth. This gives an "observed life" table of the type shown on Exhibit 3. Actually, this table is too "bumpy" to be of much value, so we have to fit a curve to it. Exhibit 4 shows a smooth curve fitted to the raw data using the Gompertz-Makeham formula; unfortunately, the mathematics involved here *is* fairly complicated so I will not attempt to go through it. Using the best actuarial traditions, you will note that we have, in this case, an average service life of 15.3 years.

Well-Chosen Short-Cuts Can Make It Easier

As a short-cut method, which almost anyone can apply, we find that a straight-line fit (Exhibit 5) works nearly as well as the Gompertz-Makeham curve for determining average life. In this case, we get an average life of 15.0 years, compared with 15.3 years using the more accurate procedure. Here again, this type of analysis is quite easy to do, once it has been set up in the form of a self-explanatory worksheet.

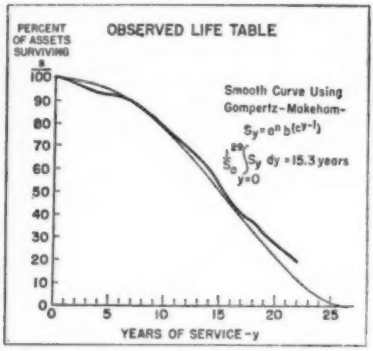

EXHIBIT 4

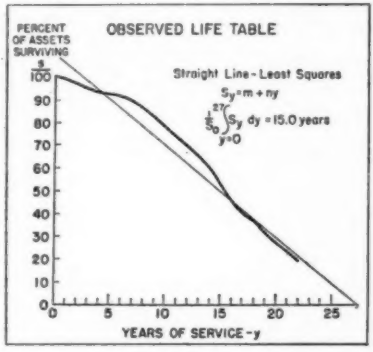

EXHIBIT 5

We have also attempted to fit a quadratic curve, like a parabola, but find that this is not particularly satisfactory because it generally curves down to the years of service line too rapidly, and, therefore, tends to give us a shorter useful life than it should.

Some Experiments; Familiarity with Formulas

Another type of experiment which has been conducted is a joint enterprise of product-cost-accounting and computer people. This involves the taking of physical inventory, using sampling techniques. In this experiment (Exhibit 6), the physical inventory was segregated into 41 classes. The inventory was then taken in two ways. First, on the night before the regular inventory day, all items were classified as high or low-value and a 20 percent random sample of the low-value items was counted and recorded. Second, the inventory was given a 100 percent check using regular physical inventory procedures. The results of the sample estimates (as prepared from 20 percent of the low-value and all high-value items) are compared with the actual values for each of the largest classes. In total, the variation of the physical inventory, estimated from the sample, was only one half of one percent of the actual physical inventory. Encouraged by

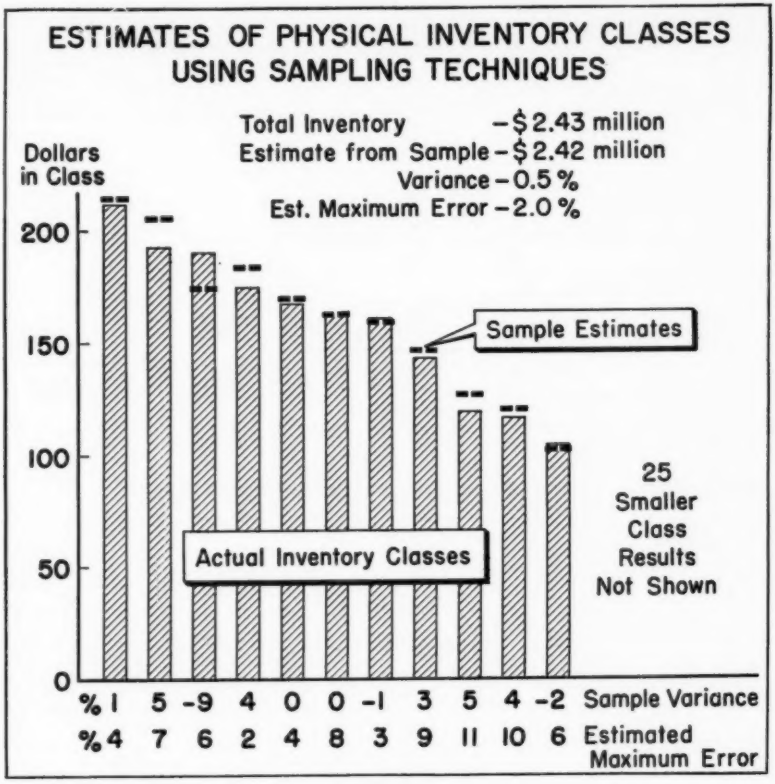
ESTIMATES OF PHYSICAL INVENTORY CLASSES
USING SAMPLING TECHNIQUES
Total Inventory – $2.43 million
Estimate from Sample – $2.42 million
Variance – 0.5 %
Est. Maximum Error – 2.0 %
Dollars in Class
200
150
100
50
0
Sample Estimates
Actual Inventory Classes
25 Smaller Class Results Not Shown
% 1 5 -9 4 0 0 -1 3 5 4 -2 Sample Variance
% 4 7 6 2 4 8 3 9 11 10 6 Estimated Maximum Error

EXHIBIT 6

this and similar experiments, the cost accounting people are trying other procedures with several departments to determine optimum sampling size and procedures. Obviously, this kind of work does not require a computer to perform it, but the calculations involved are speeded up considerably by the development of a standard computer program.

On the subject of computers, Exhibit 7 can be used to illustrate another point. This complicated-looking little formula is really not as "bad" as it appears. All it says is that the idle time, $f(t)$, is the difference between total cycle time, C, less the time, a, required to perform the tasks at particular work stations. If the task is assigned to the work station, x is 1; if it is not assigned, x is 0. Obviously, the closer we come to minimizing idle time, the better balance we achieve on an assembly line. The little tabulation in the lower portion of the exhibit may be recognized as a small matrix involving three tasks and three pos-

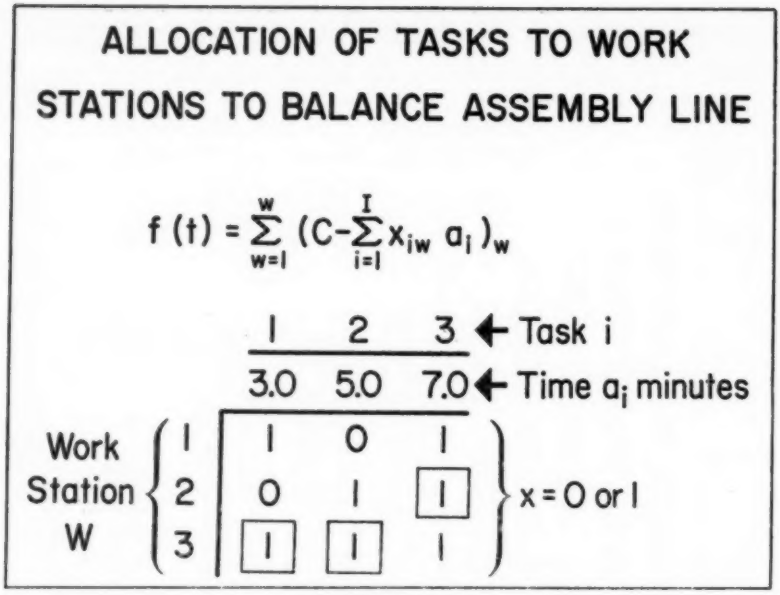
ALLOCATION OF TASKS TO WORK STATIONS TO BALANCE ASSEMBLY LINE
$f(t) = \sum_{w=1}^{W} (C - \sum_{i=1}^{I} x_{iw}\, a_i)_w$
1 2 3 ← Task i
3.0 5.0 7.0 ← Time a_i minutes
Work Station W
1 1 0 1
2 0 1 1
3 1 1 1
x = 0 or 1

EXHIBIT 7

sible work stations. The optimum solution is to perform Tasks 1 and 2 at Station 3 in 8 minutes while Task 3 is being performed at Station 2 in 7 minutes. In this way we have a cycle of 8 minutes and idle time of only one minute for each unit of production.

Mathematics Is a Tool — Not a Substitute for Creative Thinking

This is a theoretical exposition of a very practical problem. The production control people in manufacturing are faced with the reassignment of tasks to different work stations every time that the level of required production per day is changed. Simply to reassign these tasks (without any effort to minimize idle time at the various stations) used to require about 50 man-hours of production scheduling at one plant. First application of the computer to this job reduced calculation time to about two seconds.

This only gets the production line going, however. It does not solve the problem of balancing the line, that is, assigning tasks most efficiently so as to minimize idle time. Actually, the mathematics helped to make this problem clear but had very little to do with solving it. It was not until we were able to put this balancing problem on a computer that it was possible to work out a

way to minimize the idle time on the production line. The computer works out, within certain limits, all possible solutions to the task-assigning problem and prints up the results. By quickly checking the two or three solutions showing the least idle time, the production control people can rapidly establish a balanced situation for a new rate of production on the line.

Another computer application, which is easy to describe, is the allocation of state taxes among more than 100 multi-state departments. First, the tax for a given state is computed for all departments operating within that state. Then the factors that apply to Department A are dropped out and the tax is recomputed for the remaining departments. The same procedure is followed for Department B, Department C and so forth, dropping out one department each time. The difference between total tax and tax computed without each department in succession, forms a basis for allocation of the total tax among the departments. In other words, the taxes are allocated over the effect which each department has on the total tax.

This is the reverse of several cases which have been illustrated. Previously, the mathematics looked complicated, but the procedure involved was actually quite easy. Here the procedure involved sounds quite simple, but the mathematics is difficult; so difficult, in fact, that there is no reasonable way to illustrate it here.

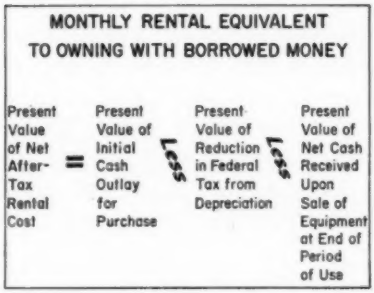
MONTHLY RENTAL EQUIVALENT
TO OWNING WITH BORROWED MONEY
Present Value of Net After-Tax Rental Cost
=
Present Value of Initial Cash Outlay for Purchase
Less
Present Value of Reduction in Federal Tax from Depreciation
Less
Present Value of Net Cash Received Upon Sale of Equipment at End of Period of Use

EXHIBIT 8

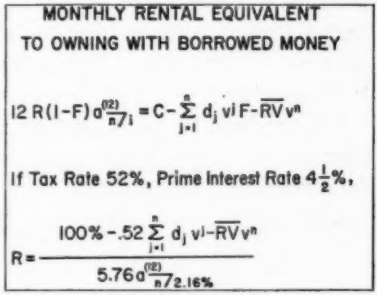
MONTHLY RENTAL EQUIVALENT
TO OWNING WITH BORROWED MONEY
$12\,R(1-F)\,a^{(12)}_{\overline{n}/i} = C - \sum_{j=1}^{n} d_j\, v^j F - \overline{RV}\, v^n$
If Tax Rate 52%, Prime Interest Rate $4\frac{1}{2}\%$,
$R = \dfrac{100\% - .52 \sum_{j=1}^{n} d_j\, v^j - \overline{RV}\, v^n}{5.76\, a^{(12)}_{\overline{n}/2.16\%}}$

EXHIBIT 9

One last illustration shows a way which was devised to "sell" a mathematical analysis to operating management. The basic concept is not really very difficult; it is expressed in words on Exhibit 8. In brief, we can equate the total cost of renting with (1) the amount we pay for a facility less (2) the tax reductions from depreciation less (3) the cash we receive when the facility is sold, net of Federal taxes, all on a present-value basis. This kind of explanation is much easier to understand than the top formula on Exhibit 9, which says the same thing. The left segment represents the present value of some rental, *R*. On

the right side of the equation, we have groups of terms showing the first cost, *C*, the present value of the sum of tax reductions from depreciation and the present value of the net residual value. By rearranging this formula a little and assuming a 52 percent tax rate and a 4½ percent prime interest rate before taxes, we have a very useful concept shown by the lower formula on Exhibit 9. We call it a monthly rental equivalent to owning a facility with borrowed money. We have established a worksheet procedure, so it is easy for anyone to fill in the requisite period of use, depreciation deductions, etc. He can then determine a monthly rental for comparison with financing through leasing. If the latter costs more than owning in terms of a monthly rental, we would be inclined to buy the equipment, and vice versa. The formula you see here has been largely used for amortization leases of equipment; with the addition of a few terms, however, it can be used for the evaluation of ordinary leases, or leases of land and buildings.

Had is not been for this way of presenting the calculations, it would have been much more difficult to secure acceptance for this particular concept.

A Large Area Is Open to Application of Mathematics

The mathematical approach has been used to analyze many other financial problems at General Electric, which we have not attempted to cover here. In most of these cases, the problem is of special rather than general interest. In other cases, such as the transportation problem, the literature on the subject is already fairly complete.

It is my hope that some of these thoughts have been of interest. Two impressions are of prime importance: first, that accountants can be taught to use the mathematical approach as it is being applied today and, second, that accountants should be using mathematics a great deal more than they now are.

Integration of Materials Accounting— A Public Utility Case Study

by WILLIS R. COX and JOHN S. ODOM

FROM INFORMATION issued by the Hoover Commission in dealing with management of paperwork in the Federal Government, it appeared that 25,000 papers and documents had accumulated per employee. However, this compared favorably with 64,000, 56,000 and 34,000 in typical companies varying in size and type of industry. If these figures are hard to believe we can comment that we felt so, too, until we started investigating our own maze of paperwork about five years ago.

The first survey in our investigation covered accounting for materials used in constructing long-distance pipelines and appurtenant facilities. Our studies disclosed that over 70 percent of the transaction detail was on items the cost of which aggregated less than one percent of the total expenditures for materials. Another survey brought out the fact that all materials used on each constructed property were listed at least nine different times. This series of records and documents was maintained largely by repeated transcriptions. In addition to the preparation of actual records and documents involved, there were audit and verification procedures, many of them routine in nature, which added to the cost of processing each series of records. The information we developed was outlined in a report to management.

General approval was given to our recommendations for integrating material accounting both within the accounting function and with related data in other areas. Our long-range objective is a highly-mechanized and fully-integrated system of data processing for all types of materials used by our company. In working towards this objective, we have used the building block approach, working out problems in each section of processing, one section at a time. We believe most people instinctively resist sudden or drastic change in their work methods or habits; few people are so unreasonable as to fight gradual change. Because of this approach, we have had excellent cooperation in all areas in which we have worked to date. In addition to better cooperation, we have found that

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JOHN S. ODOM is a Senior Accountant with the same company.

Both Mr. Cox and Mr. Odom have been active in the planning and development of the system described in this article.

working plans out section by section offers another advantage. Very few people are able to visualize a system from a set of flow charts, nor can they wax enthusiastic over the usual memorandum describing a wonderful new system. Not even a liberal sprinkling of magic symbols and phrases such as E.D.P., integrated data processing, work simplification, etc. is really persuasive. The most important paperwork in their minds is that which flows across their desks. In order to convince individuals that the new routine is feasible, you need tangible evidence of the paperwork you propose to use as a replacement. You can have them on your side if you can show them a machine tabulation that is simplifying the work of a particular person and then demonstrate that adding a five or six digit number to his tabulation will relieve them of the rubber stamp routines they follow daily. Further reassurance comes when you are able to point out that relief from routine tasks increases the importance of jobs.

In three areas of planning—catalog development, property accounting and stores accounting—our work is well advanced. In two other areas—invoice processing, requisitioning and purchasing—we have very general outlines of a program. In one area—field construction records—our plans are in the formative stage and need further study before we can come up with any concrete proposals. Our experience and our planning in each of these six areas are set forth in this article.

Catalog Development — Our First Step

The most extensive task we had was to develop a catalog which would meet our record requirements without overloading our machine-accounting section with unnecessary detail. Before we even attempted to develop a catalog, we consolidated all minor materials under one listing and assigned a special catalog number to this group. After this unnecessary detail had been eliminated, we were ready to proceed with development of a materials catalog.

As our first step, we selected typical samples of the several types of property and organized items of material by related groups. Each separate item used in the typical installations was listed on a 3″ x 5″ file card. These cards were then shuffled and reshuffled to determine the best grouping of items, eliminate duplications and ascertain the best spacing of code numbers to allow for flexibility in expansion. Space limitations made it necessary that we try various combinations in an effort to compress the maximum in descriptive information into the spaces allowed for descriptions at the three different levels we use. These levels are outlined below:

1. A master card containing a maximum of 72 columns of descrip-

Composite Listing of Materials - Detail Card

```
      HOUSE TRNSMTR GALV IRON
30 121 6971311                        24X18X10I          2 EA      133.33          4988 101 3541 12 16 0000 58
                                                                   133.33  *1

      INSULATION FIXED  SUM PAYMENT
27 127 7055371                        TE8-11050          1 FS.  40,953.87          4988 101 3541 11 16 0000 58
                                                                40,953.87  *1

      LANDSCAPING MATL
05 109 7092141                        FERT           1,040 LB      37.70          4988 101 3521 12 16 0000 58
05 109 7092141                        SEED             308 LB     124.40          4988 101 3521 12 16 0000 58
                                                                   162.10  *1

      PWR PACK MDL 9J1 BRI 120V 60CY
30 121 7183171                              -2A          2 EA      110.86          4988 101 3541 12 16 0000 58
                                                                   110.86  *1

      RECEIVER OM1M500-14 BRISTOL 0-1500#    12IN D
30 121 7183551                        693971-2A          1 EA      242.99          4988 101 3541 11 16 0000 58
30 121 7183551                        693972-2A          1 EA      242.99          4988 101 3541 11 16 0000 58
                                                                   485.98  *1

      RECRDR 2M1M500   BRI 0-1  0# 2 PEN 12 V 60CY
30 121 7184031                        693970-2A          1 EA      458.00          4988 101 3541 11 16 0000 58
                                                                   458.00  *1
```

EXHIBIT 1

tive data. This card is used where a separate card can be used for description only. One example would be a composite listing of materials at a property location. In such a listing, the master card will appear first, followed by detail cards. The detail cards contain information as to quantity, unit, amount, serial or other identifying reference numbers, and complete accounting classification (Exhibit 1).

2. A priced inventory description with 29 digits of description plus 11 columns which may be used for supplementary description or for serial numbers, motor numbers, or other identifying information (Exhibit 2).
3. A condensed description with 18 digits. A reference column of 9 digits may be used for supplementary description or for serial numbers, motor numbers, or other identifying information (Exhibit 3).

Any of the three levels of description may be produced from the same master card. The sheets on which new catalog numbers are entered before being included in the master deck of catalog cards are blocked off at 18, 29 and 72 columns. Each new entry in the catalog is arranged to include the maximum of intelligible information at each level of description. In order to do this, we abbreviate descriptive information and the manufacturer's name. The former is usually abbreviated by omitting vowels. The latter is condensed to three letters, usually the first three letters of the name. Where there is conflict, we improvise (Example—Westinghouse—WES; Weston—WSN).

For three years, the catalog was used exclusively by the property accounting section. After it had been thoroughly tested there, is was decided to place stores accounting on machines. In our earlier studies, we had discovered a fundamental conflict in requirements of the two sections. The stores section is concerned with the detailed descriptions necessary to meet procurement specifications, while the property accounting section requires general identification of an item and obtains specific identification by use of serial numbers, motor numbers, etc. If property accounting used descriptions as detailed as those of stores accounting, we would have over 100,000 numbers in our materials catalog instead of approximately 17,000. We are, at present, operating satisfactorily with a compromise catalog which gives each section the type of descriptions it requires but does have some duplications in a few areas. We hope eventually to find and gain acceptance for some device which will enable both sections to use the general description that property accounting requires for master card descriptions. A sub-listing of procurement-type information would be used to supplement the master card where needed to meet stores accounting requirements.

Priced Inventory Description

3521	6	102	5328801	BRICK BUFF SM FACE	6660051-X	9,144	EA	787.22
			5337255	CRANE 5TON LYPTA TRG-D TOP R	LJ1072	1	EA	5,221.13
			5339751	DECKING QTR #3 20GA ROBERTSN	FLOOR	2,432	SF	1,023.85
			5339751	DECKING QTR #3 20GA ROBERTSN	ROOF	3,593	SF	
			5340461	DOOR 10X10FT ALUM ROLL-UP		1	EA	416.00
			5343351	DOOR 3X7FT ALUM SGL SWING		5	EA	2,054.19
			5344701	DOOR 2F6X6F8 ALUM SGL SWNG		4	EA	1,553.42
			5355651	INSLTN FIBERGLASS WALLS&ROOF	ROOF	3,593	SF	1,380.99
			5363451	MONITOR ROOF CMPLT W/ADJ LOUVRS BRDSCRN		1	EA	1,296.04
			5366851	PANEL STNLS STL EXTERIOR WAL	EXT-WALL	2,840	SF	12,505.16
			5370951	ROOFING BUILT-UP 20YR TAR & GRAVEL BOND		1	FS	1,672.00
			5378401	STEEL STRUCTURAL	TE8-11082	78,305	LB	12,132.57
			6604541	FAN HART NP36-F ELEC PANEL 36IN W/AUTOMA		2	EA	748.44
			6660141	WINDOW OBSERVATION F/FIREWAL	6F4X4F3	1	EA	398.57
			6927201	HNDRAIL 1-1/2 ALUMINUM W/FTGS		388	FT	542.89
			6978111	HYDROMENT TILE RED COLORING F/CONCRETE		2,400	LB	365.31
			7170201	MATTING 3/16X24IN ROBBINS SAFTY-TRED		300	FT	295.02
								42,392.80 *1
								42,392.80 *2

EXHIBIT 2

Condensed Inventory Description

30	121	6971311	HOUSE TRNSMTR GALV	24X18X10I	2	EA	133.33		4988	101	3541	12	16	0000 58
							133.33	*1						
27	127	7055371	INSULATION FIXED	TE8-11050	1	FS	40,953.87		4988	101	3541	11	16	0000 58
							40,953.87	*1						
05	109	7092141	LANDSCAPING MATL	FERT	1,040	LB	37.70		4988	101	3521	12	16	0000 58
05	109	7092141	LANDSCAPING MATL	SEED	308	LB	124.40		4988	101	3521	12	16	0000 58
							162.10	*1						
30	121	7183171	PWR PACK MDL 9J1	-2A	2	EA	110.86		4988	101	3541	12	16	0000 58
							110.86	*1						
30	121	7183551	RECEIVER OM1M500-	693971-2A	1	EA	242.99		4988	101	3541	11	16	0000 58
30	121	7183551	RECEIVER OM1M500-	693972-2A	1	EA	242.99		4988	101	3541	11	16	0000 58
							485.98	*1						
30	121	7184031	RECRDR 2M1M500	693970-2A	1	EA	458.00		4988	101	3541	11	16	0000 58
							458.00	*1						
							42,304.14	*2						

EXHIBIT 3

Property Accounting — Initial Area of Application

In planning our program for property accounting, we started with the end-product in the property accounting series—the continuing property record. By applying our coding to that record, we tested the system against the accumulated experience on property over a period of 7 or 8 years. As a further test of the flexibility, we tried it in various other areas of property accounting. These test-checks indicated the system would work satisfactorily and was adaptable to the varying situations at the different levels of processing.

There was another incentive for starting with continuing property records on the new system. We were faced with a reclassification of $64 million in property from gas to oil service. Both the regulatory accounting and the functional classifications in the oil accounting vary considerably from those used in gas accounting. Having the basic record on punched cards gave us flexibility in converting from one set of property records to the other. We are nearing completion of that reclassification and the system has worked well. A previous reclassification of $143 million in similar property had taken five years and employed from 30 to 65 employees. We will complete the current reclassification in less than two years with a maximum of 18 employees (including machine-accounting personnel).

We have almost completed the punched card record on all our property accounts in the gas division and have much of the detail complete on property accounts in the carrier property division (oil). Information punched in each card includes materials catalog number, 18 columns of description, 9 columns used for identifying information (such as serial numbers) or for supplementary description, quantity, unit, amount, work order, location and accounting classification. The first machine tabulation of detail cards will list all accountable materials added or retired, by account and account subdivisions, at each property location. Summary cards will be punched as these tabulations are run. In each succeeding year, we will start our tabulations with the previous year's summary card and list in detail the current year's transactions which add to or retire property. A new set of year-end summary cards will be punched as the tabulation is being run for use in the following year.

We now have in the testing stage a procedure that will put details of construction-work-order materials on machines. That particular operation is expected to show little gain in over-all efficiency. It is, however, one of our building blocks in the long-range approach. As soon as we have worked this procedure out, we can use the information in helping to develop our invoice processing on machines.

In addition to ledger records we are now able to produce, as a by-product, certain reports required for property accounting. These include priced completion inventories to support construction work, order closings, lists of property at each plant location, company-wide lists of property by like size and kind, and machine comparisons of completion inventory quantities against construction-work-order quantities, for reconciliation of work orders prior to closing. Among future possibilities which we foresee for the use of punched card detail on materials in property accounts are: machine-priced retirements, actuarial studies of property service lives and insurance valuation reports.

Application to Stores Accounting

After three years of experience with punched card records on materials in property accounting, it was decided to make stores accounting the next area of development. Within a year after the property accounting section had set up accountable materials and miscellaneous minor materials, the stores accounting section adopted a similar system. Stores accounting charges to expense any purchases of minor materials. Since stores inventories are mainly used for maintenance and for operating supplies rather than for construction, we were faced with the necessity of developing a new group of catalog numbers. In addition to standardizing all descriptions, we had to organize many of the maintenance parts by types of equipment which they maintain. Because of the new catalog requirements and the problem of teaching over 100 storekeepers new techniques, we put stores accounting on machines gradually, one operating division at a time. During a three-month transition time we paralleled punched card records with hand-posted ledgers. After the new system had proved itself to be satisfactory, we abandoned the hand posting.

Stores issues are now priced by machines, using a company-wide average from decks which are up-dated monthly. Stores inventories are carried at 124 locations scattered from the Mexican border to New York City. This company-wide averaging causes over- or under-pricing at many of the locations. Net differences, however, are relatively minor and are written off annually as debits or credits to stores handling expense.

By sorting differently, we tabulate two types of machine-runs from the same set of stores accounting cards. Each of the runs lists location, material class, materials catalog number, 18-digit description, voucher reference and subreference, transaction code, quantity, unit, unit price, amount, maximum stock level and date of last transaction. One of the runs serves a stores accounting function, listing item balances and details of transactions for each stores location. The

second run is organized in such a manner as to list, for the proper operational group, all materials over which the operational group exercises control. For example, the chief electrician is furnished with a consolidated listing of everything electrical in stores throughout the system. He is then able to make a comparative review and quickly determine the items which require stock level adjustments at the several stores locations.

Maximum and minimum stock levels, as well as re-order points, were established for each location at the time stores accounting was put on machines. These levels and re-order points can be revised by the operating department only. A repeat requisition system was set up based on information developed. Although the repeat requisition is subject to manual processing in the requisition and purchasing phases at the present time, it includes catalog numbers and stock level controls on each repeat requisition. When we carry machine accounting into the requisitioning and purchasing phases, we will also be able to process repeat requisitions on machines.

There have been three main benefits of machine processing of stores accounting to date:

1. It gives readily available system-wide information on the location of materials which are needed for emergency repairs.
2. It facilitates comparisons between stores locations of inventory on hand. Surplus stocks have been disclosed by these comparisons and steps taken to place inventories on a more uniform level.
3. Two stores men were previously required to be continually traveling to stores locations, taking physical inventories. Inventories are now accomplished by sending runs of stores items to each location, quantities and amounts being omitted. Personnel in charge of stores at each location inventory the stores at the location and pencil in the quantities. The completed inventory is then sent in to the general office for checking against book balances and investigating any discrepancies. Spot checks of field inventories are still made by our auditing staff as part of its internal control procedures.

Invoice Processing — Plans for the Future

One of the major areas of processing of source documents on materials lies in the processing of invoices for payment and the classification of charges from them to the various accounts and codes. Most of the processing in this area can be accomplished on machines, once the fully-integrated system is set up. Because it comes as a by-product of the integrated system, invoice processing will probably be one of the last areas in which our full program can be installed.

In order to give some idea of our plans, we list our proposals below, none of which has been adopted to date.

There are three source documents in this area—purchase order, material receiving report and vendor's invoice. In processing these documents, we hope to use paper tape punched by attachments on adding machines or listing-type calculators. As common language to be used throughout the series of transactions, we will use a number opposite each item of material ordered. One of our proposals calls for the use of purchase order and item number as the common language medium. The second proposal would use requisition bill of material and item number as the common language.

All source documents will clear through an invoice processing (I. P.) desk which will batch source documents by groups of numbers. The batches will be assigned to an accountant in the I. P. section who will prepare punched paper tapes on each document. Purchase orders and material receiving reports will be coded by use of information on the individual documents. Invoices will be checked against tabulations of order and receiving cards as a source for "common language" numbers to be used in machine-processing. Paper tapes for each batch of documents will be forwarded to the machine room where a tape-to-card converter will convert the tape to order cards, receiving cards and invoice cards. Once a day all these cards will be machine-matched. Cards will be considered matched where there is no significant variation in quantity or amount. Matched sets of order, receiving and invoice cards will be sorted by vendors and listings by vendors will be sent to accounts payable section for vouchering and payment. Receiving cards and/or invoice cards which show significant variations will be shunted out and sent to the invoice processing section for investigation. Unmatched invoice cards will be tabulated in a separate listing and also sent to invoice processing section for investigation. Unmatched order cards and receiving cards will be returned to card files. Once a week a tabulation will be run, listing unmatched receiving cards.

We have considered, and believe we have reasonable solutions to, several troublesome problems in this area. In both the receiving and invoice processing phases, we have considered partial shipments, over and/or under-shipment and substitutions on shipments. In connection with invoice processing we will have practical methods of handling discounts (either cash or trade), freight charges and sales or use taxes but have not yet tested our proposals. By carefully controlling the decks of cards, we can use machine-matching to replace checking for previous payments to vendors. Matching purchase-order quantities and amounts against invoice quantities and amounts will replace verification of pricing. Two methods can be used in verification of freight charges. One

method would include freight in the purchase-order price. Another method would be the use of a separate code for freight-with routing of invoices on freight to a separate section for verification of correctness. Classification of charges will be accomplished by interpreting the classification from order cards into the invoice cards.

Problems in Mechanizing Requisitioning and Purchasing

One of the problems yet to be solved, if mechanized processes are to be used for requisitioning and purchasing, is that of exact descriptions required for procurement purposes. The 80-column card we presently use in materials accounting does not have sufficient room for some descriptions. In other instances, we have plenty of space in the 80-column card but prefer that the property accounts not be overburdened by the minor distinctions required in certain purchasing situations. We are considering several methods for overcoming this difficulty. One method would use sub-catalog numbers to provide supplementary descriptions to be used for procurement only. Another would store the catalog numbers on magnetic tape where the 80-column limitations would not apply. A third method would type purchase orders on a Flexowriter and take off on paper tape the basic description to be used in other records. The purchase order description would be used only on the typed purchase order, itself.

Take-offs of bills of material from construction drawings will necessarily be manual. We can have our choice of two approaches at that time:

1. We can start our integrated processing at the requisition level. Under this proposal, each item will be numbered on the bill of material in sequence by pages, by items on each page. This will provide a key number, or common language, for identification of materials in each of the succeeding material transactions. Information to be punched into the requisition card will include: work order number, bill of material page and item no., materials catalog number, quantity, unit, account classification, job location. If we use this approach, each bill of material will have a column for entering as-built quantities opposite each item. By using the key number, we can easily enter corrections in the original bill of materials to convert it to an as-built inventory. Because of the inventory feature, we believe that it will be best to start our integrated processing at the requisition level.
2. We can also start our integrated processing at the purchase-order level. As purchase orders are typed, the typist would reproduce in paper tape attached to the typewriter the information to be used in

the other stages of integrated data processing. Key number or common language in the integrated process would be the purchase order and item number. (Item Number 15 on Purchase Order 10463 would be 10463—15). Information to be entered in the paper tape and converted to order cards would include purchase order and item number, materials catalog number, quantity, unit, amount, vendor number, work order and/or account classification.

Where processing is started at the requisition level, the requisition cards will be matched against surplus material cards from stores and from construction. A requisition on surplus material can be machine-processed from the matched cards. Unmatched cards and partly matched cards will be machine listed for purchasing action. Order cards and the other cards in the sequence will be prepared by entering the new information from each processing cycle in a card, together with the key number. The key number can then be used to match the card with the original requisition card for interpreting the repetitive portion of the information to be used in that particular card. It has been previously mentioned that we will be able to process repeat requisitions on machines when machine accounting is extended to include requisitioning and purchasing.

As a by-product of integrated processing from the requisition or purchase order levels, we can maintain machine-produced records of several reports, such as: commitment control, cash forecast, budget report on materials and status reports for use in expediting materials.

Planning to Minimize Field Construction Records

Because of the necessary time lag in processing documents through the general office, we have had to maintain on each major construction site a set of records that duplicates certain of the permanent records kept in the general office. We are currently experimenting with methods to eliminate certain of those duplications. Two of the steps to minimize this field record-keeping are outlined as follows:

1. Use of a quantity received column on the purchase order to eliminate preparation of separate receiving reports. Under such a proposal, two copies of the purchase order would be sent to the receiving location. One copy would be retained for local records; the other would be the official receiving copy. Advisory copies for distribution to the different departments which need to be informed of the receipt of materials will be prepared in the general office.

2. Converting the original bill of materials to an as-built inventory, by use of an as-built column on the construction bill of materials.

Preparation of the actual inventory could be completed in the general office from information on these bills of materials.

In addition to these two devices, we believe that a field material ledger can be eliminated by proper file maintenance, coupled with weekly tabulations from the general office. This will be especially so if processing is started at the requisition level.

A Good Start on a Long Journey

It should be readily apparent from this article that we still have a long way to go to reach our objective of a fully-integrated system. We solicit an exchange of ideas with others who have had similar experience or who are engaged in planning in this field.

Serving Two Masters with One Accounting System

by M. D. PROUTY, JR. and J. R. SEVERIN, JR.

MANAGEMENT AND GOVERNMENT are two great forces which are at work in the business life of America today. When we distinguish management from government, in a business sense, management, to us, consists of those members of the business community who manage business enterprises as opposed to government as a sovereign power which directs, controls or rules. This distinction is necessary in view of the fact that governments sometimes engage in activities which are similar to those of private enterprises and involve similar management problems.

Business management does not operate in a vacuum. Each and every business decision must be made in the light of the facts which surround it. These facts involve production, transportation, marketing, finance, employee relations, public relations, and a host of other matters. Among these and not the least important today is government.

Even if a sovereign power does not consciously set out to influence the decisions of business management, its acts, by their very nature, have a profound bearing on business decisions. In America today, government exercises not only this indirect and, in a sense, inadvertent influence but, in certain instances, consciously exerts its power over certain areas of our business life. In time of war, this power may be all-pervading, extending to the control of prices, wages and rents, the allocation of materials and manpower, and other areas. In time of peace, the exercise of control is limited to those segments of the business community which are considered to be affected with a public interest. Our public utilities are among those enterprises which are subject to continuing regulation.

The Accountants' Dilemma

In a regulated industry, the accountant has a dual responsibility. In addition to being responsible to management for getting the facts and correlating them

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with their causes, he must also provide government with the data which it considers to be necessary for effective regulation.

Effective utility regulation involves the balancing of the level of service afforded the public with the rate level required to maintain that level of service. It also involves the balancing of private interests with those of the public. It must be exercised within the framework of our free competitive economy and under the pattern of law established by our constitution. Since our free competitive economy usually channels goods and services to the consumer at a price which somewhat approximates their economic cost and since our constitution forbids the confiscation of private property without compensation, the result has been for regulatory bodies to require rates which are based generally on cost. Regulatory bodies have tended to think in terms of cost, whether it be original cost, reproduction cost or cost of service.

The emphasis on cost under regulation has led government to look to the accountants for at least some of the tools with which to regulate. What more natural place to turn for information on cost than to the accounts of the utility company involved? But it became apparent almost immediately that, if the accounts were to provide the necessary data, they must not only be adequate but also the records of all like companies must be kept on a uniform basis. For this reason, the laws creating regulatory commissions have given to them the authority to prescribe uniform classifications of accounts for those utilities which are subject to their jurisdiction.

Thus, the accountant in a regulated company is faced with a dilemma. If he is to provide management with the data needed for decisions, he must establish a system of accounts based on the functions of this particular business organization. On the other hand, he is required to keep his books according to a uniform system of accounts prescribed by government and designed to serve an entirely different purpose. He cannot keep two sets of books, so what is he to do? One solution to the problem is to build enough flexibility into his accounting system so that it can serve both purposes.

Multiple-Purpose Accounting

Although the need for multiple-purpose accounting is particularly apparent in regulated industries, it is not peculiar to this particular field. Actually there are very few, if any, businesses for which the accounts can be said to serve only one purpose. In both government and private industry, the need for cost data, accurately determined on an accrual basis, conflicts with the need for information concerning cash sources and requirements. Cost accounting must be compared

with cost budgets. Cash flow must be compared with cash budgets. This elementary conflict exists in all businesses and, to a certain extent, in all fields of endeavor which require the keeping of accounts. And, of course, there are other conflicts, too numerous to mention.

Accountants have met the need for multiple-purpose accounting in several ways. Probably the simplest way to meet this need is by means of supplementary analyses. It is also the least dependable. Supplementary analyses are best suited to dealing with a problem on a "one-shot" basis. Where they are used to deal with a continuing problem, they involve, at best, a certain measure of duplication of effort. A better method is to build into the accounting system, itself, the channels for collecting multiple-purpose data needed on a continuing basis.

In larger companies, the use of punched card or electronic data processing have helped further the development of multiple-purpose accounting. The utility field is particularly well adapted to the use of this type of equipment since many utility companies have large numbers of accounts receivable and other accounts involving a tremendous volume of fairly simple transactions. For this reason, it has become common practice in the larger utility companies to maintain accounts according to functional responsibility as well as according to the prescribed classification of accounts. With punched card or electronic data processing, the same data can be grouped in one way for one purpose and regrouped in another way for another purpose by making another run, provided it is properly coded in the first place. In smaller companies, the problem is more difficult. Hand-posted accounting systems, by their very nature, tend to be inflexible. However, with careful forethought, it is possible to design an accounting system which will serve most of the needs for responsibility accounting and for regulatory purposes.

Uniform System of Accounts as Prescribed

Our company is a small natural gas transmission company which owns and operates a pipeline extending through three states. It buys all of its gas from a single supplier whose pipeline connects with that of our company at three different points. It sells its gas on a wholesale basis to both municipal and privately owned gas distribution systems for resale by them to ultimate consumers. It also sells gas directly to a number of large industrial consumers for their own use.

Since our company buys and sells natural gas in interstate commerce, it is subject to the jurisdiction of the Federal Power Commission under the provisions of the Natural Gas Act of 1938, as amended. Under the Act, the com-

mission has authority to authorize the construction or abandonment of facilities, fix and determine rates for natural gas sold for resale, and prescribe the system of accounts to be used by the company. Rates for direct industrial sales are not regulated, because natural gas for industrial use is sold in competition with other fuels.

Our company's accounting system must conform to that described in a document published by the Federal Power Commission in 1940 and amended from time to time since that date. It is entitled, "Uniform System of Accounts Prescribed for Natural Gas Companies Subject to the Provisions of the Natural Gas Act." The National Association of Railroad and Utility Commissioners also publishes a similar document entitled, "Uniform System of Accounts for for Gas Utilities," which is prescribed by most state regulatory bodies for those gas utilities subject to their respective jurisdictions.

The Federal Power Commission prescribes approximately 250 operating expense accounts together with detailed instructions for their use. In general, operating expenses are broken down into the following major groups for which general ledger controls are maintained:

Production expenses.	Customers' accounting and collecting expenses.
Transmission expenses.	Sales promotion expenses.
Distribution expenses.	Administrative and general expenses.

. . . Extended and Adapted to Responsibility Accounting

The expense accounts described above and their subaccounts are the ones with which we must concern ourselves from the standpoint of responsibility accounting. Depreciation and taxes are handled on a direct cost basis, since these items, together with interest and amortization of debt expense, are determined for the most part at the time the initial investment is made. Depreciation and taxes on autos and other equipment used in operations are charged to clearing accounts which are used to accumulate all costs related to such equipment. The costs thus accumulated are then distributed to the appropriate operating expense and other accounts on the basis of the relative use of the equipment.

General responsibility within the company is divided among operations, sales and finance, with one executive in charge of each. Operations is further divided into pipeline, measurement and engineering departments.

The pipeline department includes three crews stationed at three different points along the pipeline. These crews have specific lines assigned to them as their primary responsibility and one crew, which operates out of company headquarters, also operates specialized equipment wherever needed on the pipeline.

In addition to the pipeline, this department operates and maintains two compressor stations.

The measurement department is responsible for the operation and maintenance of all of the company's measuring equipment. This includes purchase meter stations, which measure the volumes of gas purchased, sales meter stations, which measure the volumes of gas sold, and intermediate stations, which check the volumes and pressures at various points on the pipeline. This department is also responsible for dispatching, meter reading and gas accounting. Its primary responsibility is to the vice president in charge of operations but it maintains close liaison with the manager of sales in regard to interruptible sales and other matters affecting the company's load factor. It furnishes the accounting department with all of the data used for billing purposes, except the price.

The first step in establishing responsibility accounting in a regulated company is to determine the extent to which the uniform system of accounts provides the necessary data. We reviewed the subaccounts under each of the categories listed above, to determine whether or not it should be further subdivided according to responsibility.

Production expenses under the uniform system are divided into numerous subaccounts covering various possible methods of producing, purchasing and storing gas. The only subaccounts which apply to our company are the ones relating to the cost of gas purchased from other pipelines, the costs of measuring such gas, and credits for the portion of such gas used by other departments. Thus, by using the uniform system without modification, we can determine the portion of production expenses which can properly be assigned to the measurement department.

Transmission expenses as broken down in the uniform system of accounts are not well adapted to responsibility accounting. All functions of the pipelines department and engineering department and some of the functions of the measurement department are included in this category. However, the primary breakdown is determined according to operation and maintenance, with some elements of each department's activities contained under each heading, in the manner illustrated below:

OPERATION

759.1	Operation supervision and engineering
759.2	Operation labor
759.21	Mains operation labor
759.22	Compressor station labor
759.23	Measuring and regulating station labor
759.24	Other operation labor

759.3	Operation supplies and expenses
759.31	Mains operation supplies and expenses
759.32	Compressor station supplies and expenses
759.33	Measuring and regulating station supplies and expenses
759.34	Other operation supplies and expenses
759.4	Transmissions maps and records

MAINTENANCE

760.1	Maintenance supervision and engineering
760.2	Maintenance of structures and improvements
760.21	Maintenance of compressor station structures
760.22	Maintenance of measuring and regulating station structures
760.23	Maintenance of other structures
760.3	Maintenance of transmission mains
760.4	Maintenance of compressor station equipment
760.5	Maintenance of measuring and regulating station equipment
760.6	Maintenance of other transmission system equipment

MISCELLANEOUS

761.1	Rents
761.2	Transmission and compression of gas by others
761.3	Joint expenses—Dr.
761.4	Joint expenses—Cr.

We did find, however, that by regrouping the above accounts for reporting purposes, they could be used to provide us with a broad breakdown by departments. That is, by grouping all of the "mains" accounts in one section of our reports and all of the "compressor station" accounts in another, it is possible to readily obtain the total pipeline department expenses. Likewise for the measurement department. The "other" operation and maintenance accounts are minor in amount and apply to the pipeline department, so are included in it.

In order to relate pipeline expenses to the various crews responsible for them, it was necessary to go beyond the analysis provided by the uniform system. We considered several possible approaches to this problem. One approach would have been to isolate the labor charges for each crew, as determined from the payroll for the members involved, and relate materials and other charges to the activities of those individuals. Since we are a small company and our books are kept manually, this approach would have been cumbersome and could probably have been followed only by preparing supplementary analyses outside of the regular accounting records. In addition to being cumbersome, this approach had a disadvantage from the theoretical standpoint. Each foreman has primary

responsibility for the operation and maintenance of a definite section of the pipeline. At times, it is necessary to shift men temporarily from one crew to another in order to get the work done. In some cases an entire crew may be assigned to temporary duty in the area of another. We have already pointed out that the crew stationed at company headquarters operates specialized equipment which may be used in either area. Furthermore, the terrain in one area differs from that in another. For these reasons, an atempt to relate costs to responsibility on the basis of crew members would be meaningless.

We have used an alternative method which makes more sense to us, both from a practical and a theoretical standpoint. It is relatively easy for us to break down those transmission operation and maintenance accounts which relate to the pipeline department according to individual pipelines. This has been done by setting up each such account on a columnar ledger sheet with separate columns assigned to each pipeline. Since each foreman is responsible for certain pipelines, the costs for which each is responsible can readily be obtained by grouping the costs according to particular pipelines.

Some of the accounts thus broken down involve supervision and labor only; others involve supervision, labor and other expenses. Although the most complex of these accounts, maintenance of transmission mains, contains 45 columns, the system is not as cumbersome as it might appear to be. All payroll, material voucher and other charges are coded according to location and as to whether they are for supervision, labor or other expense. In order to accomplish this, it is necessary only for the person incurring the charge to know where the work is being performed and to report that information to the accounting department. The numerical coding is done by the accounting department.

Approximately thirty standard journal entries are used. Payroll, for example, is journal entry number four every month. Items are grouped within each entry and spread according to code. This reduces the burden of posting. Only vouchers are posted individually. The voucher register carries only the major control accounts. Our standard ledger page has three columns on the right for debits, credits and balance, and five columns on the left for subaccounts. When more than five subaccounts columns are required, additional short pages carrying only the subaccounts are inserted in the ledger. Only one column is devoted to each subaccount. Increases in a subaccount are posted in black and decreases in red. A typical ledger page is shown on Exhibit 1.

Distribution expenses involve the operation and maintenance of our sales measuring stations. Since all this activity is the responsibility of the measurement department, no further breakdown by responsibility is required. However, we do break these accounts down according to the type of customer responsible

TRANSMISSION EXPENSES

ACCOUNT - Compressor Station Labor — ACCOUNT NO. - 759.22

Sheffield		Decatur		Date		Post.			
Supervision	Labor	Supervision	Labor	1958	Description	Ref.	Charges	Credits	Balance
759.221	759.222	759.223	759.224						
479.00	1,577.66	310.53	503.33	Jan. 31	Total Jan.	JV4	2,870.52		
520.15	1,455.36	533.54	1,375.28	Feb. 28	Total Feb.	JV4	3,884.83		
999.15	3,033.52	844.07	1,878.61		Year to Date				6,755.35
453.44	931.28	36.83	151.83	Mar. 31	Total Mar.	JV4	1,573.38		
1,452.59	3,964.80	880.90	2,030.44		Year to Date				8,328.73
26.69	140.27	16.74	36.72	Apr. 30	Total April	JV4	220.42		
1,479.28	4,105.07	897.64	2,067.16		Year to Date				8,549.15
67.75	54.87		15.61	June 30	Total June	JV4	138.23		
1,547.03	4,159.94	897.64	2,082.77		Year to Date				8,687.38
11.74	28.63			July 31	Total July	JV4	40.37		
1,558.77	4,188.57	897.64	2,082.77		Year to Date				8,727.75
			20.20	Sept.30	Total Sept.	JV4	20.20		
1,558.77	4,188.57	897.64	2,102.97		Year to Date				8,747.95
		15.73	20.45	Oct. 31	Total Oct.	JV4	36.18		
1,558.77	4,188.57	913.37	2,123.42		Year to Date				8,784.13
176.22	545.95	41.01	167.52	Nov. 30	Total Nov.	JV4	930.70		
1,734.99	4,734.52	954.38	2,290.94		Year to Date				9,714.83
525.69	2,037.96	304.29	1,079.87	Dec. 31	Total Dec.	JV4	3,947.81		
2,260.68	6,772.48	1,258.67	3,370.81		Year to Date				13,662.64

EXHIBIT 1

for the costs. The uniform system of accounts also provides us with a satisfactory analysis of customer's accounting and collecting and sales promotion expenses according to responsibility but, here again, we separate the data according to type of customer.

Administrative and general expenses include a wide variety of accounts, some of which involve responsibility of general officers, while others are directly related to field operations. A complete responsibility accounting system would assign to each area of responsibility its portion of such items as insurance, workmen's compensation, employees welfare expenses and pensions. We have not yet reflected this step directly in our accounts, although the items are segregated by type of cost and the necessary loading percentages are made available for planning purposes.

Multiple-Purpose Reporting

Providing the necessary segregation of accounting data is only one of the steps necessary in order to make the accounts serve more than one purpose. The accounting function involves synthesis as well as analysis. Each of the reports should reflect the grouping of all pertinent data in such a way as to best serve each intended purpose.

Reports to regulatory bodies must be made in the form prescribed by each regulatory body having jurisdiction. The forms provided are usually fairly detailed and are so designed as to permit them to be prepared from data furnished by the uniform system of accounts.

Reports to management should be so prepared as to conform to the requirements of responsibility accounting. In our case, pipeline operation and maintenance costs are shown according to pipeline and the cost per mile and per inch mile of pipe is disclosed. The cost of operating and maintaining each compressor station is also shown. The following costs applicable to the measurement department are disclosed: (1) operation and maintenance of purchase gas measuring stations, (2) intermediate measurement and dispatching of gas and (3) salaries, expenses and other costs related to measurement and accounting for gas sold. Administrative and general expenses are listed and grouped according to responsibility. The report is so designed that it can also be related to the figures reported for regulatory purposes.

Using the Accounting System Better — and Improving It

Perhaps the most important lesson to be gained from a review of the account-

ants' dilemma under regulation is that it is not insoluble. If an accountant is willing to exercise the necessary initiative, he can arrange a governmentally-prescribed system of accounting and reporting in such a way as to provide management with all of the data which it needs in a manner which will make the information relevant.

There is also an added advantage which can come about from a determined attempt to make a regulated accounting system serve the needs of management. By studying a regulated system with the needs of management in mind, the company's accountant obtains a better understanding of the areas in which the prescribed system is in need of improvement. Thus, he is in a better position to advise his regulatory body as to desirable changes in the prescribed system. Regulation, like accounting, is continually changing. Only those who are thoroughly familiar with the problems involved and approach them constructively can hope to influence these changes in the direction of improvement.

One of the primary purposes of government regulation is to ensure that the capabilities of management shall be exercised effectively in the public interest. As accountants, we have an opportunity to help both government and management to accomplish their purpose. Let us use this opportunity.

Reporting to Management — New Frontiers for the 1960's

by ARTHUR H. SMITH

SINCE THE TURN of the century, and particularly since World War I, the accounting profession has developed many new techniques, programs, and refinements. For example, the 1920's saw a great surge in cost accounting—particularly in standard costs. The 1930's, in turn, saw many important developments in accounting systems and equipment. Machine accounting—and particularly punched card equipment—came into strong prominence. Also, toward the end of this decade, budgeting and budgetary control surged into increasing importance, and the merits of flexible budgets versus fixed budgets was debated long and furiously in many articles and speeches. After an understandable slowdown during the days of World War II, the middle and late 1940's saw development of break-even analysis, profit graphs and distribution costing and analysis. During the 1950's, there came into prominence such techniques as direct costing, refined methods of capital investment evaluation, the use of return on investment as a managerial control tool, and the first steps at integrated data processing.

It can well be asked, "What is there left for the 1960's?" Is it possible that there are still other areas which the accounting profession can develop as aids to better management and control over operations? Yes, there will be outstanding developments in several important areas. For example, increasing discussions in such areas as replacement cost depreciation and the use of scientific sampling techniques for auditing and internal control procedures give hints of the future.

However, the real and dazzling opportunities for further accounting service to management in the 1960's will come through the integrated use of such equipment and methods as electronic computers, high-speed communications, operations research and scientific management. Here is where there are new frontiers to challenge us and where there are breath-taking opportunities to in-

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crease the accounting profession's capacity and capability to serve operating management. New concepts of scientific management, new kinds of office equipment and new accounting methodology are providing added opportunities for improved planning, forecasting and control over operations, for faster and more effective analysis and reporting of historical results. But most important is the unfolding area of *predicting* the effects of future plans and decisions on the enterprise.

This area is so broad and complex that most companies will find it advantageous to have both the internal or company accountant and the outside or public accountant contribute their joint talents and efforts in arriving at the most successful methods of reporting financial information to management. Each of the two has special opportunities, training, and capabilities. The company accountant knows in detail the company structure, its policies, management personalities, products and problems of production and distribution. He knows the internal reporting problems and procedures and the many complex interrelationships among functions and departments. On the other hand, the outside or public accountant has a more detached, impartial and independent viewpoint. He has also the benefit of experiences arising out of his work with other companies. In recent years, many public accountants have branched strongly into areas of management services other than the traditional ones of auditing, tax service and preparing financial statements. By equipping themselves to serve in wider areas of management services, the C.P.A. is placing himself in the forefront of those who can help management to meet successfully the competitive challenges of the future.

Ten C's of Good Reporting

Some years ago, I created a memory jogging type of gimmick which I called the five C's of good reporting. With additional experience and thought in this area, the list has been added to until now it has grown to be the ten C's of good reporting. No doubt, other C's can and will be added as new thoughts and concepts develop in the area of management reporting. For those who are interested in this type of reminder, the ten C's can be summarized as follows:

1. Correct—the report should be accurate, within practical and needed limitations.
2. Complete—the data should contain all necessary items for performance, accountability and decision-making.
3. Concise—the report should be brief.

4. Clear—the interest and meaning of the report material should be obvious, without any ambiguity in its presentation.
5. Comprehensive—the report should go beyond just being complete and clear from the historical or reference standpoint; it should contain enough supporting evidence and auxiliary material to point out major implications, possible courses of action and supplementary interpretations.
6. Comparative—whenever possible, actual data should be measured against some standard, estimate, previous figure, industry data or other form of yardstick.
7. Celerity—the report should be issued as quickly and speedily as practical.
8. Candid—the report should be unbiased and completely objective.
9. Considerate—the report should be "personalized" from the other fellow's viewpoint and appeal as a "help" to him.
10. Coordinated—the report, wherever possible, should be part of an integrated system of reports.

Performance vs. Information Reporting

Another comment which seems important in any discussion of reporting financial information to various levels of management deals with the distinction between a "performance" report and an "information" report. Essentially, all reports of financial and statistical information to management can be divided into these two broad classifications. The distinction between the two is important because each serves different goals or objectives.

The performance report is an accountability report. Its purpose is twofold:

1. To tell the reader how he has done in the areas for which he is directly responsible for performance. It answers the question: "How have I done?"
2. To motivate the reader to generate the direct action necessary to improve performance.

Information reports are issued for the purpose of providing the reader with information relevant to his areas of interest, although not necessarily directly associated with his specific responsibility for performance. Hence, information reports serve a broader and different set of goals than do performance reports. For example, some of the goals of information reports are:

1. They are part of the communication system of the company designed to keep specified management levels informed on company progress and condition.

2. They provide management with the knowledge to do a number of things more skillfuly, including:
   a. greater participation in formulating company policies,
   b. more intelligent participation in decision-making,
   c. more effective suggestions to other management areas for improvement.
3. They provide members of management with increased feeling that they are part of a team—a sense of "belonging."
4. They motivate and stimulate management to exert more effort and creativity for the benefit of the enterprise as a whole.
5. They develop and broaden management abilities for more important responsibilities.

The differences in goals and purposes between performance reports and information reports obviously have important influences on their structure. The affected areas are primarily in the amount of detail shown, the categories of information displayed, the style of the report, the factors emphasized, the frequency and the speed of its issuance, the number of copies and the methods of duplication. It is essential that the accountant recognize these differences in an appropriate and effective manner.

One further thought on these two classes of report may be helpful. In the usual scheme of reporting financial information to management, more attention seems to be given to performance reporting, than to information reporting. This difference in emphasis is understandable and, perhaps, quite natural. The goals of performance reports and accountability requirements are more specific and tangible than the objectives of information reports. In the short view, performance reports are probably more important than information reports because of the immediate and pressing needs to keep the business "on course." However, from the long view, bearing on the progress and growth of the business, information reports are fully as important, if not more, than performance reports. And, if you accept this conclusion, then a careful examination of the structure, content and frequency of preparation of both classes of reports is in order to ensure an effective job in both areas.

New Tools and Techniques; Electronic Computers

With these principles as a background, let us explore those developments which have set the stage for tremendous advances in the reporting of financial information to management. These developments, or tools, carry such bizarre

terms as automation, integrated-data processing, operations analysis, electronic computers and scientific management.

These techniques and tools have given tremendously increased capabilities in the areas of accounting service, analysis and reporting. To be truly effective in our accounting and reporting responsibilities, full advantage of the increased capabilities must be taken in developing and channeling financial data to management. In fact, it should be emphasized that further developments on these tools are coming so fast that what is being written today will become obsolete in the very near future. Constant obsolescence lends even greater emphasis to the need to keep abreast of this changing field. It should be emphasized, also, that these tools are not the decision-makers, or an end in themselves. They are merely the means by which management can be assisted through better and faster data to carry out its decision-making responsibilities more effectively.

One of the biggest and certainly one of the most glamorous is the electronic computer. Its capabilities have completely revolutionized the horizons of communications, giving wide flexibilities in the speed and sequence of report preparations, in the depth and scope of report content and report distribution, in the diversity of report comparisons and summaries and in the integration of reports to various echelons of management. There are many varieties and sizes of electronic computers, ranging from small and often-times special-purpose machines to giant, general-purpose digital computers with capabilities for performing almost any kind of business or scientific application. And for those companies too small to justify leasing or owning such facilities, service bureaus exist where machine time can be purchased as needed. The computers, coupled with new developments in peripheral equipment, such as the input data machines, tape-to-card and card-to-tape converters, with the processed tapes as by-products of other operations, and high-speed, complex wire communication systems enhance further the capabilities for analyzing and reporting financial data in one form or another.

Integrated Data-Processing; "Total Systems" Concept

The very existence of these types of tools encourages, in fact, requires us to go deeper into such areas as integrated data-processing and "total systems" concepts of data handling and processing. Actually, the concept of integrated data-processing has been around now, for quite some time. There have been numerous applications of its principles, particularly in the shipping order, invoice and payroll fields. While such applications have been helpful and progressive, they have been hampered until recently by lack of the proper equipment to carry

these principles to their fullest use. However, there are now equipment capabilities with calculation speed, storage and input-output flexibility that finally make possible the application of a complete "total systems" concept of data handling and processing. For example, a single writing of input data from the customer's order can accommodate all management data requirements triggered by that order. Included are sales volume levels, credit requirements, production planning and scheduling data, manufacturing needs, loading and shipping instructions, traffic routings, transit billings, purchasing information, accounting entries and management reporting at all levels. Functional lines are crossed and recrossed as the order flows through the areas related to its fulfillment. Departmental walls are knocked down as feedback returns to various functions from the common trail. We are now looking at what is truly a total system, serving the requirements of each function of the enterprise from a common source, rather than having each function or department largely developing its own records and reports independently.

It should be emphasized, of course, that no one should harbor any illusions that we have reached the ultimate capability for recording, analyzing and reporting data to management for decision-making. There is no doubt for a minute that further strides in these areas will be made. Rather, the emphasis is on the great strides that have been made, and the urgent need to use these new techniques to the fullest extent. Also, one other point should be emphasized clearly. No one is so completely enamored of these machines as to believe that some form of machine application is the answer in every case. It has been demonstrated over and over again that there are many areas of transmitting financial data to management where simple clerical routines are more effective and less costly. These might include the daily reports of cash flow, the shift reports of actual and standard performance and the daily sales totals. However, these instances should lull no one into a false feeling of comfortable security. These instances in no way negate the tremendous possibilities for improved reporting which exist in many other areas through the application of improved tools and techniques.

Operations Analysis and Research; Forward-Looking Approach

Now, add one more tool, and maybe the most important, namely, operations analysis and operations research. Merely to apply present methods and procedures to the machines is to gain only part of their capabilities. To reach the optimum, there is need for a searching, objective, unbiased and thorough review of all departments' requirements in order to tailor-make this total system in the

most effective and efficient manner. This means a complete overhaul and "new-look" at work flow, report and paper work, handling sequence, detail and summarized data, form design and distribution, operating needs, inter-function and inter-department relationships. And, what is more important, this new-look should be not only from the standpoint of streamlining the efficiency of the present "figure factory." It should also start from the standpoint of defining the basic requirements of both management and the customer and determining the optimal methods that will best serve both. Often we have been too figure-oriented or even too management-oriented. This may sound like a strange statement. However, that company which provides its customers with the best products, the best price and the best service will be the most likely to succeed.

Hence, we need to find out through these objective operations analyses, not only what management thinks it needs for effective performance but, also, what the customer expects in the way of product, price and service. This raises such basic questions as plant location, quality control tolerances, transportation methods, sales service and many others. Also encountered is the thorny problem of centralized versus decentralized sales and production administrations, accounting services, etc. Operations analysis can accomplish this "new-look," in fact, it has done so for industry under approaches variously identified as methods analysis, procedures review, cost analysis, management engineering, forms analysis and systems charting. Add, now, to the methods of operations analysis, such mathematical and statistical techniques of operations research as linear programming, queuing theory, response surface analysis, model design, multiple correlation, simulation probability and design of experiments; these and others like them are powerful tools which can often contribute exceedingly well to our total "new-look." Properly blended with other concepts and analyses, there evolves a thorough and forward-looking program that will match requirements to the right machine and equipment. It will do so in a way that optimizes the capabilities of both the machine and the accountant to provide the data to manage the business and to serve the customers.

The foregoing comments have dealt only briefly with certain major tools and concepts that have in the past few years increased tremendously the capabilities for providing management with financial data to manage the business. To these developments can be added the impressive array of accounting techniques and methodologies which have been created and refined over the past years and which include flexible budgets, direct costing, break-even analysis, return on capital employed, capital investment evaluation, etc. Coupled with the expanded capabilities for financial reporting given us by computers, integrated data-processing and operations research, there is now at our command a tremendous array

of new methods, concepts and techniques for developing an effective means of providing financial information to all levels of management.

Before concluding, there is one more point to emphasize, namely, that the greatest service to management lies in providing it with the necessary data to predict what will happen, as contrasted to an historical analysis of results. The real payoff for these new machines and new techniques is in what they can tell us of the probabilities of the future happenings. In this day and age of complex business transactions, it is not enough to be a mere historian of figures. No longer is there justification in simply recording and reporting. It is necessary to assist and encourage all areas of management to forecast, plan and control toward objectives. The accountant must apply his aptitudes, abilities, training and experience to help guide the business to pre-determined patterns of maximum profits. Communication of financial information to management must emphasize the future effect of decisions and plans. Let us measure *now* the full effect of decisions *before* they are implemented. Let us ensure to operating management that there is strong reason to believe (or not to believe) that such decisions will help guide the business to maximum profits. To look ahead, using such methods of sound financial planning, and then to provide management with the necessary data to steer toward the goals of such planning, will be to provide our operating people with the kind of accounting service to which they are entitled.

Facing Up to a Tremendous Challenge

In summary, then, the accounting profession has been given tremendously increased capabilities during recent years in the areas of recording, analyzing and reporting financial information to management. There has been put at its disposal an impressive array of tools, techniques and concepts. It includes such things as computers and peripheral hardware, integrated-data processing, operations research and accounting methodologies as direct costing, flexible budgeting, break-even analysis and return on capital employed. We face a tremendous challenge to blend all of these tools, concepts, and techniques into a hard-hitting, fast, effective and efficient system of communicating financial data to management. Those of us who do the best job in these areas will give our managements a tremendous competitive advantage. Clearly, these new frontiers of management reporting represent a great challenge facing us during the "sensational sixties." We must meet it vigorously and aggressively to justify the faith and confidence which management has placed in us as the custodian and disseminator of financial information.

Accountants — Automatons or Thinkers

by MICHAEL J. LYONS*

THERE has been a gradual evolution of accounting in the past two decades, but it is apparent that accounting today does not measure up to the dynamic growth of the economy. This is due in a large measure to horse and buggy thinking in an atomic and automation age. It is time that much of the obsolete textbook distributions and redistributions be discarded, for strict adherence to outmoded principles only tends to make a mockery of accounting.

There is no denying that there is a vast industrial revolution taking place in our time. We, as accountants, are emulating the ostrich who buried his head in the sand. To meet the growing need and keep pace with changing economic conditions, an accounting revolution has become a vital necessity.

Gone are the days when an accounting graduate well steeped in auditing procedure and accounting principles and practice had the necessary training to be an accountant. This training, by itself, created pedants who lived by the book and were guided by a set of principles no longer valid. The very inculcation of that book learning and digestion of principles left little or no room for initiative and creative thinking.

This situation was never healthy. In processing claims on terminated war contracts during and immediately following the second world war, strict adherence to the book, especially by certified accountants, was frequently a hindrance rather than a help. The need for creative thinking was present then and is much more imperative today.

New factors badly need recognition. Our accounting principles have been formulated over the years through tradition, usage and general acceptance. Many of the principles presupposed, and were predicated on, the recognition of the dollar as a standard measure of value. Prior to the year 1933, we had a stable dollar with an exact value in terms of gold and, therefore, no special problems developed. But, since desertion of the gold standard, the dollar has lost much of its real significance as a measure of value. Does it not follow that the accounting concepts which were sound while we had a dollar with a fixed gold value may be open to question when the dollar is steadily losing value?

There are many other areas for reappraisal under the extraordinary conditions prevailing today. Special scrutiny should be given to the traditional principle of "cost or market, whichever is lower." Closely related is the practice of depreciating capital assets over useful life, based on cost. There are two major obstacles, viz. accelerating obsolescence and unequal economic values. Our present accounting

* Cost Accountant, Titanium Metals Corporation, Henderson, Nevada.

in the latter instance is no better than if we said a distance in yards, measured with 36-inch yards, is the same as the same number of yards using a 17-inch measure.

Another area where there is much confused thinking and conflict between theory and practice is accounting for capital and revenue expenditures. Theoretically, when a unit of equipment has a life of more than one year, it should be capitalized and depreciated over its expected life. If this can be described as a "generally accepted accounting principle," then it should be re-examined in the light of American business practice during and since the second world war.

Accountants are claiming more and more for themselves. In recent years, the tendency has been to describe the practice of accounting as a profession. The more ardent enthusiasts add the word science. If use of elementary arithmetic, addition, multiplication and division justifies its claim to being a science, then accounting is a science. What can be said as to its claim to being a profession—to be elevated to the level of law, medicine and engineering? The learned professions are guided by basic principles. Can we say the same of accounting? In consideration of many major accounting transactions, we have to weigh the balance sheet effect, the long and short-term effect, the profit effect, the tax effect, and assure ourselves that we process it in accordance with company policy, conform to Internal Revenue regulations and do all acceptable to U. S. Navy and Air Force auditors. In short, are we leading or following?

In the final analysis, accounting of the future will follow one of two diverging paths: (1) preparation of reports based on records maintained in accordance with obsolete principles or (2) true accounting based on revised principles and fully reflecting changing economic values.

As manifested in recent *Bulletin* articles, there is unmistakable evidence that accountants are awakening from their apathy and complacency. This is a healthy sign and augurs well for the future of accounting. But, since the web of conflict and confusion is intricate, it will require all the support, resourcefulness and ingenuity of accountants to unravel it.

The following course of action is both feasible and practical in my opinion. Some way should be found for representatives of the leading professional organizations—and also the U. S. Internal Revenue Service—to engage in deliberations from which might come some basic unity which might lead to a true professional standing (in the broad sense) for all accountants. In order to meet the ever-increasing challenge, accountants of the future should bring to their problems the questioning and analytical mind, rather than look for a conformity which makes it possible to learn by rote.

Making a Data Processing Center More Efficient

by WILLIAM C. HUNTER

IN SPITE OF THE FACT that numerous articles on machine data processing have appeared in the *N.A.A. Bulletin* since 1955, none of them have dealt with the efficiency of a data processing group. However, this may not be surprising since machine data processing is a new field; the development of its potentials in new applications and the solution of unanticipated problems in operation were of primary concern. Nonetheless, it is suspected that more and more companies which have passed the first hurdles may, in the near future, begin to take a hard look at the efficiencies of their data processing departments. It is hoped that the experience of the author of this paper may be of some assistance.

The Decatur plant of the Chemstrand Corporation is unusual in several respects. First, Chemstrand, formed as a joint venture of Monsanto Chemical Company and American Viscose Company, was born as a big company; there was no opportunity for trial and error experimentation through a long growth phase. Second, the Decatur location includes research, engineering and administration, as well as manufacturing, and all are served by the data processing center. The machine accounting installation referred to in this paper is of a medium size and consists of:

2 Accounting Machines (407 & 402)	1 Interpreter
2 Reproducers (519)	1 Collator
1 Calculator (604)	4 Key punches
2 Sorters (082 & 083)	3 Verifiers

In 1957, it appeared that, after two years of operation, the efficiency of the department could be improved considerably by a careful examination of its functions and the way they were carried out. This was done with gratifying results. Delays in reports having deadlines were largely eliminated, standard costs were developed, machine use time was increased and a procedure for the examination of the economics of new operations was instituted.

WILLIAM C. HUNTER, North Alabama Chapter, 1952, is General Accountant for the Chemstrand Corporation's Acrilan plant at Decatur, Alabama. He joined Chemstrand in 1952. Prior to this, Mr. Hunter practiced public accounting in North Alabama area. He was graduated from Athens College, Athens, Alabama, with a B.S. degree in Business Administration.

Basic Factors: Personnel and Scheduling

Efficiency of a data processing center depends on two things: trained personnel and proper scheduling. In these respects it is no different from a manufacturing operation, and much the same techniques can be applied.

Personnel efficiency was found to be increased by the use of well-written standard operating procedures, clear-cut job responsibilities, personnel training programs and continuing personnel development.

Standard operating procedures should be complete enough, so that operators can set up their machines and complete a job without supervisory assistance. Therefore, they should be assembled and kept up to date in manuals which cover each job. Procedure manuals in our company are divided into seven sections as follows:

1. Introduction (for administrative purposes): description and purpose of job, source documents, cards used, schedule, accounting controls and disposition of cards and reports.
2. Flow chart—a detailed flow of the job.
3. Clerical instructions: detailed instructions on source documents, accounting controls, due in and due out times, handling and disposition of cards, delivery of reports, and other matters essential to the proper handling of the job.
4. Job instructions—step by step narrative on how the job is to be run.
5. Key punch—information for operators on card layouts and source documents.
6. Exhibits—card forms, source documents, and report forms.
7. Technical—wiring diagrams, planning charts, codes, multiple card layouts and machine set-up instructions.

The fastest, most accurate and most economical techniques were used in these procedures, and provisions were made for periodic revisions as necessary. It was found desirable to make operators completely responsible for their jobs. This has increased job satisfaction and built a stronger and more flexible organization. Each person connected with the data processing center was trained through external and internal schooling on the equipment in use. Emphasis was placed on the development of effective equipment use. Each person connected with the center was required to become familiar with equipment capability and be able to use it effectively.

As a preliminary to proper scheduling of work in the data processing center, priorities must be assigned. For this purpose, jobs tend to fall into one of three categories. These are jobs which occur at regular intervals and have rigid deadlines, those which occur at irregular intervals and have either rigid or somewhat

flexible deadlines and those which are either routine or irregular but which have no deadline.

Although it might seem to be a simple matter to assign priorities, this was found to be extremely difficult, because all departments served may have jobs which fall into one or more of these categories and departments tended to overstate or to understate their requirements. In scheduling, then, we have found it necessary to work very closely with the requesting departments and thus become familiar with their requirements. A job list was constructed showing the following information for each job:

1. Job number
2. Job description
3. Frequency
4. Volume
5. Due-in time
6. Due-out time

Based on this information, operations were scheduled to obtain maximum efficiency. Many scheduling problems were solved through the use of machine utilization charts (Exhibit 1), analyzed weekly, with results which were found to be very useful. For example, it was found, in one case, that the 402 accounting machine was not being utilized effectively between 0600-0800 and 1600-1800. These gaps were filled in with jobs and, as a result, overtime dropped and more jobs were completed on time. Work was assigned on the basis of

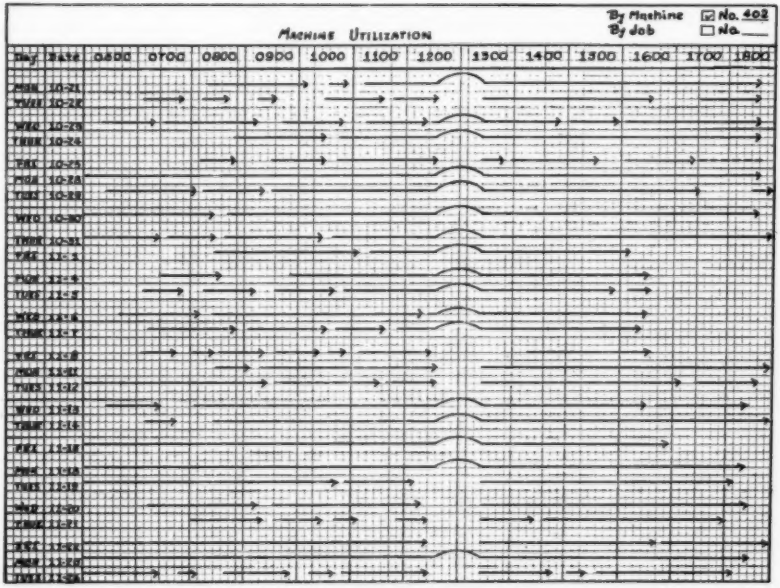

EXHIBIT 1

maximum machine utilization and job time requirements. The following factors were found to be important:

1. Due-in and due-out times must be reasonable and as flexible as possible.
2. Machine and operator requirements must be anticipated before starting new jobs, thus eliminating conflicts with existing jobs.
3. Conflicts, such as several jobs waiting for one machine, must be reduced to a minimum.

MACHINE ROOM SCHEDULE

Job No.	Job Name	Mon.	Tues.	Wed.	Thurs.	Fri.	Actual Time Out

EXHIBIT 2

PERFORMANCE SCHEDULE

Job No.	Job Name			Mon.	Tues.	Wed.	Thur.	Fri.		
100	Calculations & Checks	IN	Sch.							
			Act.							
101	Payroll Distribution	IN	Sch.							
			Act.							

EXHIBIT 3

MACHINE ACCOUNTING — LOCATION _____

MACHINE UTILIZATION

Machine Type _____ Date _____

TIME		APPLICATION	CARD VOLUME#	OPERATOR	TIME		APPLICATION	CARD VOLUME#	OPERATOR
06:00	12.0*				12:00	6.0*			
OVERTIME					OVERTIME				

EXHIBIT 4

Procedures and schedules are of little value unless they are adhered to. Operations must be followed up to assure that each job is kept on the right track until it is finished. Checks are made periodically to make certain that the job performed is in accord with the procedure flow chart. Checks are also made to see that all work is identified properly which reduces loss or misplacement of documents and saves handling time. Data are also obtained for methods improvement. The following schedules are used for accumulating these data:

1. Machine Room Schedule (Exhibit 2).
2. Weekly Performance Schedule (Exhibit 3).
3. Daily Machine Utilization Sheet (Exhibit 4).

Finally, the following accounting controls were installed:

1. Source documents are transmitted with control tapes or item counts.
2. Reports are balanced to controls before being released.
3. Reports are properly identified, dated and headed. Without identification, people receiving reports can not know what they represent.
4. Machine operators are orientated on the reports they are running with emphasis on their use and meaning.
5. Internal machine checks are applied.

Developing Standard Machine Cost Per Hour

As a part of the overall control plan, a standard cost system was developed. This was based on a standard factor for overall machine utilization. Elements entering into the standard cost were:

Labor		*Utilities*	
Salaries (direct)	—Machine and key-punch operators.	Steam	—Floor space.
		Electricity	—Total watts of equipment.
Salaries (other)	—Machine room supervisor and assistant.	Refrigeration	—Floor space.
Payroll overhead	—Percentage of salaries —direct and other.	Water	—Floor space.
		General utilities	—Floor space.
Supplies		*Occupancy*	
Machine rental	—Rent on all machines physically located in the machine room.	Insurance and Taxes	—Floor space.
		Maintenance	—Floor space.
Direct supplies	—Estimated — based on previous experience.	Depreciation	—Floor space.

The following breakdown was chosen for standard costs due to the wide variation in cost and utilization among the main items of equipment:

STANDARD COSTS — MACHINE ACCOUNTING

	Key Punch	*Printing*	*Computing*	*Auxiliary*
Machine hours	8,320	3,328	1,456	5,200
Utilization	80%	80%	70%	50%
Salaries	$20,158	$ 7,858	$ 3,390	$12,326
Rental	3,168	17,292	8,256	9,504
Supplies	300	300	150	300
Utilities	472	472	472	472
Occupancy	1,000	1,000	1,000	1,000
Total	$25,098	$26,922	$13,268	$23,602
Cost/Hour	$ 3.02	$ 8.08	$ 9.11	$ 4.54
Rental/Hour	$ .38	$ 5.20	$ 5.67	$ 1.83

Method of distribution of costs to each machine group is as follows:

1. Salaries (direct)—Key-punch operation salaries, plus payroll overheads distributed to key punch. Operator salaries, plus payroll overheads distributed on a percentage derived from the machine hours for printing, computing and auxiliary.
2. Salaries (indirect)—Distributed on a percentage derived from the machine hours for each group.
3. Supplies—Estimate.
4. Machine rental—Actual rent on machines in each group.
5. Utilities—Electricity developed from watts of equipment in each group; all other utilities on the basis of floor space.
6. Occupancy—Floor space.

Standard costs are used to determine the cost of proposed machine jobs as well as existing jobs. When evaluating existing jobs, the standard cost is applied to actual job time and factored to the overall machine utilization percentage. This gives the actual cost of the job as well as the standard for comparative purposes. The application of cost standards to proposed jobs may be somewhat misleading. For example, if actual utilization is 60% and standard cost based on 75%, the standard would be considerably lower than the actual. However, the cost standard is a realistic goal that can be obtained if pursued with proper diligence. The cost standard is indicative of what it will ultimately cost to machine process a job.

Evaluation of New Jobs

Requests are frequently received to estimate the cost of processing new jobs as an aid to deciding whether the benefit to be obtained would be justified. To assist in these evaluations, a guide was prepared:

STANDARD JOB EVALUATION GUIDE

	Degree	*Requirements*	*Weighted values per degree*	*Range*
COST SAVINGS	1.	Small cost savings	XX	XX-XX
	2.	Relieve personnel of clerical duties to perform cost saving functions		
	3.	Direct manpower savings		
INCREASED PROFITS	1.	Little or no profit increase	XX	XX-XX
	2.	Indirect increase in profits (better quality etc.)		
	3.	Direct increase in profits		
CONVERSION COSTS	1.	High conversion cost	XX	XX-XX
	2.	Average conversion cost		
	3.	Small conversion cost		
EQUIPMENT	1.	Requires additional expensive equipment	XX	XX-XX
	2.	Requires small additional equipment		
	3.	Can be done on existing equipment		
OPERATOR & MACHINE UTILIZATION	1.	Requires overtime or shift work	XX	XX-XX
	2.	Would fit in with overall schedule		
	3.	Economic utilization of operators and machines		
BY-PRODUCTS	1.	Little or no by-product value	XX	XX-XX
	2.	Potential by-product value		
	3.	Definite by-product value		
JOB TIME	1.	Job takes more time	XX	XX-XX
	2.	About the same		
	3.	Considerably less time		

ACCURACY	1. Job less accurate 2. About the same as under manual system 3. More accurate	XX	XX-XX
REPORT TIMING	1. Reports later than under manual system 2. About the same time 3. Faster	XX	XX-XX
COMPLEXITY	1. Simple manually 2. Semi-complex (due to volume etc.) 3. Complex — not feasible manually	XX	XX-XX

Weighted values per degree were assigned to each major factor and also degrees of importance to each subfactor. The mean of the range was selected as the dividing line; any job scoring below the mean would probably not be justified, scores above the mean would be worthy of further consideration. This evaluation guide is not intended to be an exact tool, but it has proved to be a useful guide. The evaluation is conducted in the following manner:

1. Each major factor is studied, evaluated and scored on the basis of the facts at hand.
2. The evaluation is discussed with the individual requesting the job.
3. If the cost is acceptable, priorities are assigned and job procedures written up.

Ground-Work for Improved Installations

This overall plan has produced many desired results. Some of them are:

Improved management.
Faster and more economical processing of data.
Increased utilization of operators and machines.
Decisions based on fact.
Flexibility.
Timely reports.
Better understanding of machine operations.
Better means of evaluating new and existing jobs.
More effective use of equipment.

Machine-accounting installations serve as indispensable data centers to a majority of industries. This requires professional management. Without complete control of machine-accounting activities, an installation will always be in trouble. Instead of getting the job done, the machine accountant will spend most of his time trying vainly to keep the situation in hand. The adoption of the control methods outlined in this paper has provided the tools for professional management.

Take Your Top Management to a Picture Show

by JOSEPH S. McCOSKER

THE SCENE of this portrayal is the conference room of a large corporation. Seated about the table are the chairman of the board of directors, the president, vice-presidents, and other officers of the company. At the rostrum, a member of the controller's staff throws the switches that turn out the lights and flash the first picture on the screen (Exhibit 1).

LOCKHEED AIRCRAFT CORPORATION
AND ITS WHOLLY OWNED SUBSIDIARIES

CONSOLIDATED FINANCIAL STATEMENTS
AND COMPARISONS TO MANAGEMENT BUDGET

FEBRUARY 1959 AND YEAR TO DATE
(DOLLAR AMOUNTS IN THOUSANDS)

EXHIBIT 1

For forty-five minutes this executive audience is treated to a silver screen showing of the company's latest financial developments. As each picture, projected from a 35 millimeter slide, appears on the screen, the controller's staff assistant gives a brief explanation and answers questions that arise. After the meeting, each member of the audience is furnished a complete set of consolidated financial statements in conventional printed and bound form. This financial statement presentation for top management takes place each month at Lockheed Aircraft Corporation.

The corporation is a major industrial corporation with facilities in widely separated areas across the United States and in foreign countries. Since 1951 Lockheed has operated under a divisional organization. Each operating division is in many ways self-contained and functions in a manner similar to an independent business, within a framework of policies, plans and controls laid down by the corporate division. Each operating division develops reports and financial statements for its own management.

JOSEPH S. McCOSKER, Los Angeles Chapter, 1952, is Manager of the Accounting and Finance Department of Lockheed Aircraft International, Inc., a subsidiary of Lockheed Aircraft Corporation, which he joined in 1950. Mr. McCosker was formerly with Lybrand, Ross Bros. & Montgomery in their Los Angeles office.

We, in the corporate accounting department, are responsible for providing top management with financial information about each division and also concerning the company as a whole. We prepare printed monthly consolidated financial statements which are distributed to top management. Over the years, we have refined the content and form of these statements so as to provide members of top management with the information which will be most useful to them. In addition, we have endeavored to improve our methods of presenting the data that we develop. About two years ago, we considered various types of graphic presentation and decided to use photographic slides because slides (1) provide vivid, clear pictures and are (2) adaptable to both statements and charts, (3) easy to prepare and (4) inexpensive.

The Statements and the Slides — Putting Them Together

The financial statements that we present to management consist of the following:

1. Statement of income and related schedules and charts analyzing income by division, by customer and by product.
2. Statement of financial position, with detail schedules and charts, highlighting areas of special interest.
3. Statement of source and application of funds.
4. Statement of cash receipts and disbursements.
5. Schedules of personnel data and labor rates.
6. Schedules of overhead expense and overhead rates.
7. Dollar and unit information on backlog and airplane deliveries.

Ordinarily, we prefer not to vary the contents of our printed package so that the financial statements can be used as an unbroken historical record and so that the persons using them can make comparisons between periods. However, as the financial situation changes, we add or drop schedules from the slide presentation. Since the 40 minutes to an hour alloted for the showing do not give us time to show all of the printed statements, those not of current interest are culled from the showing.

In adapting our printed financial statements to slides, we soon learned that slide material must conform to certain rather rigid rules; otherwise a slide will be illegible or confusing, and would fail to get the message across. We have found that we are able to make slides of uniformly high quality by following these simple rules:

1. The opening in a 35 millimeter slide mask is 24 millimeters by 36 millimeters. Therefore, all copy must be in two to three proportions (3″ x 4½″, 4″ x 6″, etc.).

2. The number of words, lines and columns on a slide must be held to the minimum. It is better to omit details than to make them too small to read. Notes and explanations should be furnished by the narrator.
3. Because of the small size of typewriter letters, typing should be done in capitals. Typed copy pages to be photographed should not exceed 5" x 7½" in elite type or 6" x 9" in pica type. If larger pages are used, figures and letters become illegible when they are reduced to the 35 millimeter slide size.
4. We have found that carbon ribbons produce superior typewritten copy.
5. Copy for slides must be kept clean. Smudges assume giant proportions when they are projected on the screen.

In view of the limitations of the slide technique, our first problem was to tailor the information in our printed statements to fit the requirements of the slides. We were limited by the amount of material that would go on a single slide and by the number of slides that we could show at one time. We attacked the problem in three ways:

1. By eliminating certain lines and columns and shortening captions.
2. By splitting certain statements into two slides.
3. By eliminating certain statements and schedules from the slide presentation.

LOCKHEED AIRCRAFT CORPORATION
AND SUBSIDIARIES

STATEMENT OF INCOME

February 1959

(In Thousands of Dollars)

	February		Year to Date	
	Actual	Over(Under) Budget	Actual	Over(Under) Budget
Sales	$	$	$	$
Cost of sales				
Gross profit				
Spares handling expense				
General and administrative expense				
Income from operations				
Other deductions - net				
Net income before taxes				
Provision for federal income taxes				
Net income	$	$	$	$
Return on:				
Sales	%	%	%	%
Total assets - annual basis				
Net worth - annual basis				

EXHIBIT 2 (Printed form)

STATEMENT OF INCOME

	FEBRUARY ACTUAL	YEAR TO DATE ACTUAL	YEAR TO DATE OVER(UNDER) BUDGET
SALES	$	$	$
GROSS PROFIT			
G & A AND SPARES HANDLING EXPENSE			
OTHER DEDUCTIONS			
NET BEFORE TAXES			
NET INCOME			

EXHIBIT 3 (Slide form)

At the outset, we eliminated three lines from all financial statements. Since "Lockheed Aircraft Corporation," the date and period covered, and "In Thousands of Dollars" were covered in the title slide, it was unnecessary to repeat them.

A comparison of Exhibits 2 and 3 illustrates the method of reducing the quantity of material on a statement by eliminating lines and condensing captions. To make the printed statement conform to the requirements as to slide width,

LOCKHEED AIRCRAFT CORPORATION
AND SUBSIDIARIES

DIRECT AND INDIRECT PERSONNEL

AT THE END OF FEBRUARY 1959

Division	Total Actual	Direct Actual	Direct Over(Under) Budget	Indirect Actual	Indirect Over(Under) Budget	Ratio of Indirect to Direct Actual	Ratio of Indirect to Direct Over(Under) Budget
A							
B							
C							
D							
E							
F							
Total							

EXHIBIT 4 (Printed form)

we had to eliminate one column and to abbreviate some of the side captions. To make the printed form fit the height requirements of the slide, we had to eliminate or combine certain items. As a result, the statement of income is no longer a conventional multiple-step statement in which cost of sales is deducted from sales to arrive at gross profit, etc. Instead, it has become a listing of the salient items that deserve the management's attention. Subtotals and balancing figures, which are important to accountants in the preparation of the statement, are not consequential to top management. If, on occasion, one of the omitted items becomes significant, it is covered in the oral comments that accompany the slide presentation.

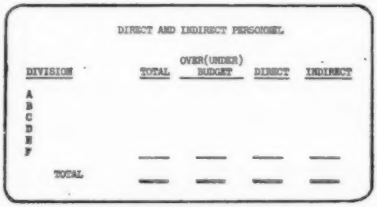

EXHIBIT 5 (Slide form)

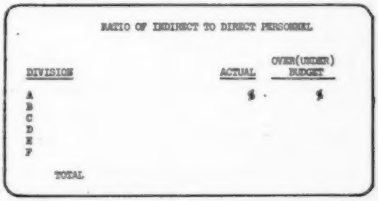

EXHIBIT 6 (Slide form)

Exhibits 4, 5 and 6 show what can be done when it is necessary to split a single statement into two statements for the slide presentation. The seven columns of figures in our printed form are more than can be shown legibly on a slide. To solve this, we re-arranged the material so that actual figures and only one "over (under) budget" column appears on one slide, while ratios are shown separately on a second slide.

Slide Presentation of Charts

Charts are particularly effective in a slide presentation. When used to illustrate a trend or a comparison, they present a picture which is easy to comprehend and lasting in impression. However, schedules are better than charts when it is necessary to show exact amounts. If charts are prepared with closely spaced grid lines and excessively fine trend lines, it is almost impossible to follow them when they are projected on the screen. The ideal chart has widely spaced grid lines and not more than two or three trend lines. Lettering on charts should be horizontal so that it can be read by the viewer without twisting or squirming.

Color slides are sometimes used, with each trend line in a different color. Although they are very attractive, we no longer use them because it takes more time to prepare the copy and process the slides. Also, color slides, when projected

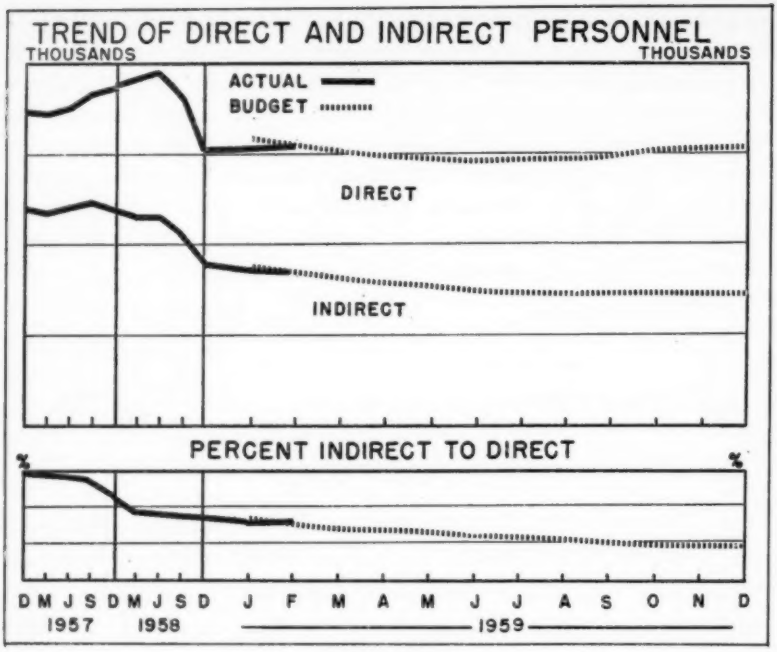

EXHIBIT 7

on the screen, present a problem if they are intermixed with black and white slides because the focus adjustment for colored slides is slightly different from the adjustment for black and white.

Our charts are set up to be used for a year. They are prepared on 8½" x 11" stock. Grid lines, headings and legends are inked in at the beginning of each year. Trend lines are added monthly with one-sixteenth inch tape. Each chart does double duty; it is photographed and reproduced for our printed statements and then photographed for the slides.

An example of one of our charts is shown as Exhibit 7. On all the charts we follow the same format to show trends, so that the audience will not lose time in learning the make-up of each chart. On these charts, we show actual results by quarters for the two previous years, and budget and actual figures by months for the current year.

Slides are quite effective when negatives (white lines and figures on black background) rather than positives (black on white) are used. Charts, in particular, stand out against a dark background. However, at the request of some of the members of our audience, we are now showing only positive slides.

Negative slides seem to be harder on the eyes, probably requiring more muscular adjustment.

Oral Comments — Source and Delivery

The narrator who delivers the oral comments which accompany the slides is the key figure in the slide presentation. In the brief period during which each slide appears on the screen, the narrator directs the attention of the audience to the significant items on it and explains any particulars not apparent from the slide itself. Following the narration for each slide, time is allowed for any questions or comments by members of the audience.

In developing our financial statements and the narration, we have followed the concept of management by exception. Under this concept, we relate our actual performance to the budget for the period and, in some instances, to performance in the prior year. In the narration, we emphasize the items that are materially over or under the budget or the prior year and explain the reasons for these variances. In developing explanations of variances, we rely to a great extent on the comments provided by the operating divisions in their financial statements. Without this help from the divisions we would not be able to analyze the consolidated statements and prepare the narration within our relatively short time schedule.

The oral comments are delivered by the controller's staff assistant who supervises the consolidation of the financial statements, since he is the person most familiar with the contents of the divisions' statements and with other items affecting the consolidated statements. The vice-president in charge of finance, who is also our controller, is present at the slide presentation and participates in the discussions as a member of top management.

Closing and Slide Preparation Schedule

Under our current program we have set a goal of ten working days after the month end for presenting the slides and releasing the printed statements. Although, in some companies, management requires financial information on a more current basis, we believe that a ten-working-day schedule is satisfactory for our purposes. The aircraft industry is a long-term contracting industry and production spans run over periods of months or years. Under these circumstances, financial information is not materially affected by day-to-day developments.

In order to meet our goal of ten working days for issuance of the consolidated statements, we have set up a schedule with assignments for each day. By the fifth

work-day, operating divisions complete their financial statements and advise the corporate accounting department, by telephone or telegram, of their net income before and after taxes. We in the corporate accounting department prepare a "flash" statement of net income by division, to be distributed to certain members of top management on the fifth day. Also on the fifth work-day, operating divisions transmit to the corporate accounting department copies of their financial statements and other information needed for consolidation.

On the sixth work-day, we prepare pencil copies of consolidated statements for both the slides and the printed statements. In order to have them consolidated in the same day, minor differences are not investigated until after the consolidation is completed. On the seventh work-day, we prepare typed copy and charts for both the slides and the printed statements. Also on the seventh day, we analyze the financial statements and prepare comments for both the slides and the printed statements. On the eighth and ninth work-days, our reproduction department prepares slides and reproduces the printed material. On the tenth working day, we make the slide presentation and distribute the printed statements.

A Practical Improvement

Our combination of slide presentation and printed statements has been effective in informing top management of the financial progress of the company. The slide presentation has provided both visual and oral methods of bringing significant items to the attention of management. The question-and-answer period serves as a forum for top personnel to discuss the company's financial problems in the light of the latest financial data available. In addition, printed statements are available for further study and as reference material. This combination costs little more than the conventional printed statements. It can be produced quickly; slides can be made while the printed statements are reproduced and bound. Although the slides are prepared by our reproduction department, the same service is available on the outside, at a nominal cost.

Since we started the slide-showing of our financial statements, we believe they have taken on a new meaning to top management. Our management has followed the slide showings with genuine interest. If you have not taken your top management to a picture show, we suggest that you give it a try. We recommend the slide medium to all those who are looking for a better method of reporting financial information.

How Much Data Screening to Minimize Computer-Detected Errors

by PHILLIPS S. CRUTTENDEN

HOW MUCH preliminary screening and auditing work should be done before transactions are entered on a computer? This question comes up frequently during the installation of a mechanized data processing system. Theoretically, the computer should be programmed to take practically all transactions in random order. It should detect most of the errors and omissions and make necessary corrections, if possible, without the necessity of rejecting the transaction and printing out the error on an error log. But this ideal in programming is seldom achievable, especially when the speed of the computer and its memory capacity are limited and when there are many complex operations to be performed, plus a heavy volume of input data. Thus, some preliminary screening and auditing is apt to be necessary.

Preliminary vs. Correction Costs

Let us assume that this problem of preliminary screening is under study by an imaginary company. This company has sufficient volume of work to justify the use of a medium-sized computer. About two years ago, it received the machine, equipped with magnetic tape units, card readers, punches and "off line" tape reading and selection devices. A major accounting procedure of the company was programmed for the computer and is now in successful operation.

The mechanized operations require a large number of separate runs on the computer, some 60 or more, plus about 10 runs of the off-line selection equipment. Some of these runs are made daily but the majority of them are scheduled at weekly and monthly intervals. Most of the editing and error detection operations take place during the first three daily runs. The other runs take care of sorting, merging and updating, plus the preparation of summary cards, lists and

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reports. On each of the first three runs, the errors which are detected by the computer are printed on an error log. All transactions which have errors or deficiencies that are not automatically corrected by the computer are rejected from further processing. These transactions are reviewed and corrected by clerks as soon as possible and are then re-entered into the system. It takes about three days, on the average, to make the error corrections and get the transactions back into the system again.

The frequency with which various kinds of errors occur has been studied ever since operations with actual data started. As would be expected, it was found that decreases in the combined error rate were shown as the personnel became more experienced with the new procedure. But when some individual kind of error showed a tendency to increase sharply, it meant that corrective measures or additional training were necessary. In some instances, the change in the error frequency led to revision of the computer programs.

Now that many of the kinks are out of the procedures, and operations are on a routine basis, the management is still concerned about the error rates. There are good reasons for this for, as the error rate increases, the backlog of unprocessed work also rises. Furthermore, it takes more time to process error corrections than it does to process a transaction initially. Besides, there is the cost of the re-runs on the computer. With equipment rentals running up to $100 an hour, plus labor, this re-run time can be costly. In addition, the clerks who correct the errors are liable to make errors too, although they are experienced and highly trained people. Because there are three separate editing runs, it happens that the same transaction may be rejected on each of the first three runs, with different kinds of errors being detected. Thus, because of the human tendency to make errors and the way the run programs have been devised, there is some re-cycling.

The error rate, or frequency with which errors occur, is a useful measure of error correction costs, provided it is based on a representative and not a small sample. It shows the care taken in the preparation of documents and the efficiency of the preliminary screening operation. Theoretically, if the field representatives prepare the source documents in a highly accurate manner and the preliminary screening work is done equally well, there will be few, if any, errors to cause rejects, and the computer error rate will approach zero. The errors which would then appear on the error logs would be errors in computation or in rate applications and similar deficiencies which are not audited or checked before they reach the computer. Thus, savings in clerical error correction costs as well as in keypunching and computer re-run time would be possible. On the other hand, if all preliminary screening is eliminated, the number of errors

detected by the computer could rise even to the point at which costs would be unacceptable. Somewhere between these extremes lies the break-even point which represents a balance between the preliminary screening costs and computer-detected error correction costs.

Break-Even Formula; Its Components and Their Interrelationship

To find the break-even point between the preliminary screening costs and computer-detected error correction costs, it is necessary to obtain reliable data on certain costs. Data on the frequency of errors, based on a large sample during the same period, is required also, and could be developed in the following steps:

1. Find the cost of performing the preliminary screening and auditing work during a representative period. Clerks doing this work spend some of their time at work which must be done manually, like batching documents for computer entry, cross referencing and making writing and figures more legible. A large part of their time is spent in looking for obvious errors, such as missing data, missing dates and references. They enter various classification codes on the documents and, at times, they check computations and extensions. Most of their work represents a duplication of the work accomplished by the computer. Therefore, theoretically, costs which represent this part of their work can be avoided, since the computer makes the same checks as the transactions pass through the system. Call these *Preliminary screening costs* and identify them with the symbol *A*.
2. Determine the frequency of errors which are found and corrected by the preliminary screening and auditing clerks during the representative period. Such information would be available because memorandum records are kept of errors, by means of detection, source of error and specific type. While records of all kinds of errors are kept, the only errors to be included in this percentage figure are those which are programmed for check by the computer and, consequently, will appear on the error logs if the clerks do not catch them first. Call this *Preliminary error rate—B.*
3. Find the cost of doing the error correction work. This would include the clerks' time in reviewing the error logs and making corrections to the input cards, some keypunching and verification time on corrected cards and computer room operators' time applicable to the re-runs only. Machine rentals, including the computer rental, should be included also, to the extent that they apply to the cost of re-runs only. All of these costs should be obtained for

the same representative period used for the preliminary screening costs. Call this *Error correction costs—C.*

4. Find the frequency of errors which are detected by the computer and listed on the error logs and adjust this rate to eliminate those errors which the preliminary screening clerks make no attempt to find, check or verify. Call this *Computer error rate—D.*
5. The above data on costs and error frequencies represents all of the factual information needed to find the break-even point as between the two methods of error correction. But first a decision must be made as to the amount of error reduction that is desired. Call this *Change in error rate—E.*
6. Finally, there is the amount of cost which we should be able to add to preliminary screening while saving an equal amount of error correction costs at the going rate for errors. We will call these *Break-even costs* and symbolize them with the letter *K.*

We now have the following:

A — Preliminary screening costs	*D* — Computer error rate
B — Preliminary error rate	*E* — Change in error rate
C — Error correction costs	*K* — Break-even costs

The relationship of these factors is:

$$(A + K) \text{ is to } (B + E) \text{ as } (C - K) \text{ is to } (D - E)$$

From this, we develop the equation for finding the value of *K*, which is:

$$K = A(E-D) + C(B + E) \div (B + D)$$

Cost Reduction Program Based on B-E Analysis Findings

Suppose we are faced with a situation in which the computer error rate is .11 percent. This seems high and we conclude that it should be reduced by .02 percent. There are several ways in which we can go about reducing the errors. First, we can step up the training of field representatives so that the source documents will come in better prepared, more complete and accurate. Or we can emphasize the training in the home office by centering attention on the people who have responsibilities in documentation, screening and auditing. We can study our computer run programs. Perhaps some revisions can be made so that more errors and omissions will be corrected automatically. And we can stimulate the preliminary screening clerks to detect more errors, provided they do not increase their backlog of incoming documents for examination. Finally, we can add more people to the screening unit or authorize overtime and thus, by increasing the intensity of the preliminary examination work, reduce the

computer error rate. How much can we increase these costs and still obtain a .02 percent reduction in the computer error rate with a comparable saving?

We have accumulated the following costs and error frequencies:

A — Preliminary screening costs	\$420.00
B — Preliminary error rate	.06%
C — Error correction costs	\$765.00
D — Computer error rate	.11%
E — The amount of error reduction proposed	.02%

Substituting these values in the equation, we obtain break-even costs which can theoretically be added to the cost of the preliminary screening work while saving an equal amount of error correction costs.

$$K = 420(.02-.11) + 765(.06+.02) \div (.06+.11) = \$137.65$$

Proof:

$$K=(420+137.65).(.02-.11)+(765-137.65).(.06+.02)\div(.06+.11)=0$$

Thus, provided our costs are reasonably accurate and our statistics on error frequencies reliable, we should be able to reduce our error rate on the computer by .02 percent if we increase our preliminary screening expense by \$137.65. Of course, we are also counting on saving the same amount in error correction costs.

Another use of the break-even formula is to find the amount of change in the computer error rate when the amount of additional preliminary screening costs, which we may think of spending, is known. For example, if we plan to spend an additional \$100 in preliminary screening, we should expect that the computer error rate will decrease .0146 percent. The equation to find E when K is known is derived from the same basic equation:

$$\text{Change in error rate} - E = D(A+K) - B(C-K) \div (A+C)$$

Substituting, we have:

$$E = .11(420+100) - .06(765-100) \div (420+765) = .146\%$$

In practice, it is best not to spend much money on preliminary screening and checking of data that the computer has been programmed to check. The computer can do the work much more completely and accurately. The best rule to give the screening clerks is: "If you see an error, correct it, but do not spend time checking items that the computer has been programmed to check."

Is Your Management Really Decentralized?

by WILLIARD E. STONE*

MANAGERIAL DECENTRALIZATION is one of the most important management techniques which has been developed in the past twenty years. The efficiency of this management structure can hardly be questioned. It is, however, a popular concept and it is probably true that in some instances decentralization is claimed where it does not, in fact, exist.

The president of one very large corporation, in writing of his company's former chief executive, said that he was forever telling the operating people that they had complete responsibility for their operations. In fact, however, the managers of operating units were subject to the line authority of vice-presidents of manufacturing, marketing, finance, labor relations, engineering, etc. An officer of another large corporation, well known for the high degree of managerial decentralization claimed for it by its chief executive, attended an executive conference at Wharton. When asked to what extent the operating unit managers of his company were autonomous, he replied that it depended upon how the chief executive felt at the time.

Certainly it must be agreed that many degrees of decentralization of management authority can be found in large corporations. Some elements of decentralization must be present in the managerial structure of all large corporations. It would be difficult to believe that the managers of operating units in even the most strongly centralized company were delegated no authority to enable them to discharge the responsibilities placed upon them. The term, decentralized management structure, is then a relative one. In order to answer the question, "is my company's management decentralized?", it becomes necessary to set up standards through the application of which it will be possible to establish the degree of decentralization which exists.

Standards of Decentralized Management

There are two major groups of such standards. The first measure the intent of top management with respect to its management structure and the second evaluate the actual authority granted the managers of operating units.

It is well known that certain large companies are strongly committed to a

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policy of decentralization. Others lay no claim to decentralization. Certainly, this announced policy must be given weight but the intent of top management should be probed more deeply.

A more discriminating test of the intent of the executives should be based on the company policy with respect to the preparation of budgets and income statements. Forecasting the expenses of a unit is a sure indication that central management looks upon it as a separate operating entity. The preparation of an income budget, in particular, is tangible, objective evidence that the profit responsibility has been assigned to the manager of the unit. Regular preparation of a profit accountability report (statement of profit and loss) is also a strong evidence. Sometimes the nature of the goods produced by one unit is such that it becomes a component part of the product of another company unit. In this event, the assignment of an intracompany transfer price to the material transferred is *bona fide* evidence that both units are considered autonomous.

The final test of the degree of decentralization of management must rest upon the amount of authority granted the unit managers. If a unit manager is to be truly autonomous, he must be given a large measure of control over all functions which affect the unit's profit. The functions of purchasing, selling, product engineering, hiring and establishing wage rates are probably the most important profit determining factors. The authority granted within each of these areas may be limited to some extent but still exist in fact. For instance, a company may make use of centralized purchasing for the economies it affords but, if the ordering (authorization of purchase requisitions) is done by the unit manager, he has control of the purchasing function. Likewise, a centralized employment department may screen applicants but, if the manager has the final say over the employment of an individual in his unit, he has control over hiring. With respect to wage rates, it must, of course, be recognized that the overall wage structure will generally be established in a company-wide manner by management-union negotiation. The autonomous unit manager should have authority over wage and salary rates within the framework of the union contract. The functions of selling and product design may also be somewhat restricted by overall company policy without removing effective control over them from the hands of the unit manager. If the unit manager is permitted, within limits, to establish a sales price for his unit's product and to find his own sales outlets outside the company, if would appear that he has control of the selling function. Again, if the unit designs its own products, its manager has authority over this function, despite some restrictions which may be placed upon minimum quality standards, company-wide standardization of certain parts, etc.

Decentralization Rank Points

The question, "is your management really decentralized?", can now be approached in a systematic way by assigning a point for each criterion of units autonomy which your company meets.

Management intent	*Points*
1. Announced policy of decentralization	1
2. Preparation of unit expense budgets	1
3. Preparation of unit income budgets	1
4. Preparation of unit profit and loss statements	1
5. Use of intracompany pricing	1
Unit manager authority	
1. To sell unit's products outside the company	1
2. To purchase materials outside the company	1
3. To establish wage rates	1
4. To make decisions regarding product design	1
Total possible points	9

In order to complete your company's rating it might be necessary to simplify the scale; so let us agree, somewhat arbitrarily, that companies with:

1 to 3 points are *centralized,*
4 to 6 points are *partly decentralized,*
7 to 9 points are *decentralized.*

Decentralization in Large U. S. Companies

It may be interesting to compare your company with other American companies with respect to type of management structure used. A study was completed

Ratings by Industry Classification

Classification	Total companies	Decentralized Number	Decentralized Percent of total	Partly Decentralized Number	Partly Decentralized Percent of total	Centralized Number	Centralized Percent of total
Fabricated metals	19	15	79	3	16	1	5
Transportation equipment	35	27	77	3	9	5	14
Textiles	18	13	72	3	17	2	11
Chemicals & Drugs	35	24	68	8	23	3	9
Electrical equipment	15	10	67	2	13	3	20
Petroleum & Coal	23	14	61	8	35	1	4
Machinery	39	20	51	11	28	8	21
Primary metals	33	16	49	10	30	7	21
Other industries	37	18	49	11	30	8	21
Paper	21	10	48	8	38	3	14
Stone, Clay & Glass	13	5	39	3	22	5	39
Food	48	16	33	20	42	12	25
Total	336	188	56	90	27	58	17

EXHIBIT 1

at Wharton in 1957 in which over 500 of the largest manufacturing corporations were contacted with a questionnaire. Almost 70 percent replied, and the results with respect to their policy concerning decentralization of management authority are as shown in the accompanying tables. The point scale developed above was used in ranking these companies and they are shown grouped by asset size in the table below and by industry classifications in Exhibit 1.

Ratings by Asset-Size Class

1956 Asset size (in millions)	Total respondent companies	Decentralized		Partly Decentralized		Centralized	
		Number of companies	% of total in class	Number of companies	% of total in class	Number of companies	% of total in class
Over $50	240	150	62	62	26	28	12
$25 to $50	50	22	44	13	26	15	30
$10 to $25	46	16	34	15	33	15	33
Total	336	188	56	90	27	58	17

The study offers empirical evidence that the decentralized management organization has been widely adopted by our large corporations. Less than 20 percent of the companies in the study make use of the centralized form of management. Although only 56 percent were rated as decentralized companies, 100 of them returned a perfect score of 8 points indicating strong decentralization.

The transportation equipment industry has, perhaps, made the strongest claim to the use of decentralized management. This claim is borne out by the study, for almost eight of ten corporations in this industry were decentralized under this rating plan. At the other end of the scale, the food industry showed the smallest number of companies with decentralized management. Only one third of the large corporations in this industry were rated as decentralized.

The large number of partly decentralized companies would appear to be an indication that the movement towards the granting of autonomy to intra-company units is still under way. It seems reasonable to forecast that, with the ever-increasing size of our corporations, the decentralization of managerial authority will assume even greater importance as an organization technique in the years to come.

Beyond These Covers

Books

Readings in Accounting (Vols. 1 & 2)

Harold M. Heckman, Editor, Georgia Center for Continuing Education, University of Georgia, Athens, Georgia, 1958 and 1959, Loose-Leaf.

Two substantial volumes of readings tested in practical use at the University of Georgia Center for Continuing Education (in cooperation with the Georgia Society of Certified Public Accountants), these readings, representing material used in successive years, cover outstanding topics in the accounting field, reproduced from periodical literature. Selections in the earlier volume deal with direct costing, report writings, financial statements presentations, management services, income determination, depreciation, changing price levels, budgeting, fund statements and developments in accounting. Those in the later volume deal with electronic accounting, standard cost, auditing and electronics, allocation of income taxes, inflation, statistical sampling, depreciation, accounting as a basis for managerial decisions, deferred compensation and the guaranteed annual wage.

Operations Research

Sasieni, Yaspan & Freedman, John Wiley & Sons, 440 Fourth Avenue, New York 16, N. Y., 1959, 316 pp., $10.25.

The summary of this book which Chapter One contains, states that it, "begins with a brief survey of the elements of probability theory . . . for basic understanding . . . discusses sampling . . . and presents various problem areas which have gradually taken distinct shape in operations research." These areas are identified as "inventory, replacement, waiting lines, competitive strategies, allocation, sequencing, and dynamic programming."

Accounting Systems

Neuner & Neuner, International Textbook Co., Scranton, Pennsylvania, 1959, 577 pp.

A college textbook on "the design, installation and revision of accounting systems," this edition includes expanded material in the areas of data processing and internal control. The organization of the book is in two sections, i.e., principles and application, the latter distinguishing the needs of various types of companies, as merchandising, manufacturing, etc.

Do They Understand You?

Wesley Wiksell, The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1960, 200 pp., $4.95.

A lively adventure into the problem of communications in business, the presentation of which this book consists, does its own communications job well with dialogue, pertinent anecdote and illustration. Particularly apparent is the recognition that communication is a two-way affair. This is embodied in a full-length section on "listening."

Accounting for Oil and Gas Producers

C. Aubrey Smith and Horace R. Brock, Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y., 1959, 536 pp., $10.65.

Background bulks large in this study of an industry's operational characteristics and their useful expression in accounting terms. The accounting organization and system itself are not scanted. Oil lease provisions are illustrated in appendices, together with a sample accounting procedure for unit and joint lease operations.

Uniform Accounting for Locker and Freezer Provisioners

Thornton W. Snead, Sr. and Paul C. Wilkins, U. S. Government Printing Office, Washington 25, D. C., 1959, Paper Bound, 47 pp.

Published as Agricultural Handbook No. 163 of the United States Department of Agriculture, this manual (with the words "guide to" prefacing the title given above) was prepared with the cooperation of the National Institute of Locker and Freezer Provisioners, from which forms illustrated in the manual are available.

Accountants' Cost Handbook

Robert I. Dickey, Editor, Ronald Press, 15 East 26th Street, New York 10, N. Y., 2nd Edition, 1960, $15.

After sixteen years, this handbook, then Cost Accountants' Handbook, has been redone under an altered title which suggests the greater recognition of the importance of cost data in the interim. The twenty sections, separately authored, include a section on Cost-Volume-Profit Relationships and Analysis and Control of Standard Cost Variances. In Section 9, which deals with Manufacturing Overhead and Product Cost, there is extended treatment of direct costing.

Principles of Engineering Economy

Grant & Ireson, Ronald Press, 15 East 26th Street, New York 10, N. Y., 4th Edition, 1960, 574 pp., $8.

This revision is, as its predecessors, a book about solving problems relating to "acquisition and retirement of capital goods," on the facts and with proper use of the facts. It is a textbook directed primarily to engineering students but also to students of "economics, accounting, finance, and management." After consideration of the planning of studies and treatment of interest, "the time element in economy," the body of the book deals with techniques for conducting such studies. Necessary tables are offered in appendices.

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